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ADVISORY CIRCULAR
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Guidelines for vertical flight facilities at aerodromes designed for aeroplanes

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Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

Artwork: James Baban.

Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This advisory circular (AC) applies to:

- aerodrome operators
- persons involved in the design, construction, and operation of airports, heliports, and vertiports.
- proponents of airports, heliports, and vertiports
- helicopter and VTOL capable aircraft (VCA) owners/operators
- air navigation service providers
- planning authorities
- the Civil Aviation Safety Authority (CASA).

Purpose

The purpose of this AC is to provide guidance to aerodrome and aircraft operators in the planning, design, and operation of facilities for helicopters or vertical take-off and landing (VTOL) capable aircraft (VCA), or both, on an aerodrome that may have only been designed for fixed wing aeroplanes.

This AC refers to these aircraft as "vertical flight aircraft" and does not provide guidance relating to RPA/drone landing sites as RPAs/drones are not defined in the AC as "VTOL capable aircraft". The information in this AC is intended to focus on aviation safety matters; however, other forms of safety may be mitigated.

It is not intended to limit aircraft operations.

Note: This AC should be read in conjunction with the Part 139 Manual of Standards (MOS) and AC's 139.R-01 Guidelines for heliports - design and operation and 139.V -01 - Guidance for vertiport design. These documents provide supporting and/or detailed information for various sections throughout the AC.

References to this information will be displayed in a Note box.

For further information

For further information or to provide feedback on this AC, visit CASA's [contact us](#) page.

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the National Manager, Flight Standards Branch.

Table 1: Status

Version	Date	Details
v1.0	March 2026	Initial issue.

Contents

1.1	Acronyms	6
1.2	Definitions	7
1.3	References	11
2	Introduction	14
2.1	Background	14
2.2	Defining the operations	16
2.3	Arrival and departure procedures	23
3	Physical characteristics of aerodrome vertical flight facilities	26
3.1	General	26
3.2	Physical facilities	27
3.3	Final approach and take-off area	27
3.4	Nominating a runway or taxiway as a FATO	28
3.5	Aiming point or TLOF	31
3.6	Nominating taxi-routes and transit routes	32
3.7	Aprons for vertical flight aircraft	39
4	Obstacle limitation surfaces	48
4.1	Aeronautical assessments	48
4.2	OLS general specifications	48
5	Visual aids	51
5.1	General	51
5.2	Options for marking the FATO	51
5.3	Touchdown/positioning markings	56
5.4	Marking the taxiways and taxi-routes	57
5.5	Marking stands and aprons	58
5.6	Vertical flight visual aids - Lighting	60
6	Published information	64
6.1	Vertical flight aircraft facility data	64

Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Table 2: Acronyms

Acronym	Description
AAM	advanced air mobility
AC	advisory circular
AIP	aeronautical information publication
ATC	air traffic control
ATSB	Australian Transport Safety Bureau
CASA	Civil Aviation Safety Authority
CASR	<i>Civil Aviation Safety Regulations 1998</i>
DPZ	downwash and outwash protection zone
DW/OW	downwash and outwash
ERSA	en-route supplement (Australia)
FATO	final approach and take-off area
FATO/SA	final approach and take-off area/safety area
ICAO	International Civil Aviation Organization
LDAH/LDAV	landing distance available (helicopter/VCA)
MOS	Manual of Standards
MTOW	maximum take-off weight
NAA	national aviation authorities (FAA, EASA, UK CAA etc)
OEM	original equipment manufacturer
OLS	obstacle limitation surface
PinS	point-in-space (instrument flight procedure)
RPA	remotely piloted aircraft
RTODAH/RTODAV	rejected take-off distance available (helicopter/VCA)
SA	safety area
SARPS	standards and recommended practices
TDPC	touchdown/positioning circle
TDPM	touchdown/positioning marking

Acronym	Description
TDPS	touchdown/positioning shoulder-line
TLOF	touchdown and lift-off area
TODAH/TODAV	take-off distance available (helicopter/VCA)
VCA	VTOL capable aircraft
VTOL	vertical take-off and landing
VTSS	take-off safety speed

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Table 3: Definitions

Term	Definition
advanced air mobility (AAM)	A sector encompassing new aerial transportation technologies, including a range of novel aircraft types including VTOL capable aircraft.
aerodrome	From the <i>Civil Aviation Act 1988</i> : An area on land or water (including any buildings, installations, and equipment), the use of which as an aerodrome is authorised under the regulations, being such an area intended to be used either wholly or in part for the arrival, departure, and movement of aircraft.
clearway	A defined area on the ground or water, selected and/or prepared as a suitable area over which a vertical flight aircraft operating in performance class 1, or a vertical flight aircraft, capable of continued safe flight after a critical failure, may accelerate and climb to a specific height. Note: Clearway is a defined term in the Part 139 MOS but it relates to aeroplane operations. The definition above is a modified version relevant to this AC.
D	For rotorcraft, the maximum dimension of the rotorcraft. Typically, it is the largest overall dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane or helicopter structure. For VTOL-capable aircraft, means the diameter of the smallest circle enclosing the aircraft projected on a horizontal plane, while the aircraft is in the take-off or landing configuration, with lift/thrust units turning, if applicable. Note: If the aircraft changes dimensions during taxiing or parking (e.g. folding wings), a corresponding D _{taxiing} or D _{parking} should also be provided.
D-value	A limiting dimension, in terms of "D", for a vertical flight facility, or for a defined area within. For example: The D-value for a size of FATO is 1.5 x Design D of the largest aircraft.

Term	Definition
design D	The D of the design vertical flight aircraft.
design vertical aircraft	means a virtual aircraft type that has the largest set of dimensions, the greatest maximum take-off weight (MTOW), and the most critical obstacle avoidance criteria of the aircraft that the aerodrome, or for a defined area within the aerodrome, is intended to serve.
declared distances - heliports	<p>Take-off distance available (helicopter or VCA)</p> <p>Take-off distance available (TODAH) means the length of the FATO plus the length of helicopter clearway (if provided) declared available and suitable for helicopters to complete the take-off.</p> <p>Where a clearway is provided then the TODAH will be the FATO length, plus the length of the clearway, plus the safety/protection area that is located between the two.</p> <p>Rejected take-off distance available</p> <p>Rejected take-off distance available (RTODAH) will be length of the FATO declared available and suitable for helicopters operated in performance class 1 to complete a rejected take-off.</p> <p>Landing distance available</p> <p>Landing distance available (LDAH): length of the FATO plus any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a defined height.</p>
disk loading	Equals aircraft weight divided by the total rotor disk area typically expressed in kg/m ² (ld/ft ²). For a VCA, total disk area is the sum of the individual disk areas of all lift-producing rotors or propulsors.
downwash protection zone	The downwash protection zone is designed to protect the general public, other aircraft and those working in the immediate vicinity of an operating helicopter or VCA from the hazards of downwash and outwash.
dynamic load-bearing surface	A surface capable of supporting all types of loads generated by a vertical flight aircraft in motion.
elongated	When used with TLOF or FATO, elongated means an area which has a length more than twice its width.
facility	Has the same meaning as in Part 139 MOS.
final approach and take-off area (FATO)	<p>For the operation of a rotorcraft at an aerodrome, means the area of the aerodrome:</p> <ol style="list-style-type: none"> from which a take-off is commenced; or over which the final phase of approach to hover is completed. <p>For the operation of a VTOL-capable aircraft, is defined as a solid area:</p> <ol style="list-style-type: none"> from which a take-off is commenced; or over which the final phase of approach to hover is completed.
FATO protection area (or safety area)	A defined area surrounding the FATO which is free of obstacles, other than those required for air navigation purposes, and intended to reduce the risk of damage to helicopters accidentally diverging from the FATO.

Term	Definition
flight manual	for an aircraft: see clause 37 of Part 2 of the CASR Dictionary.
helicopter landing site	An aerodrome, including a heliport, intended for use wholly or partly for the arrival, departure, or movement of helicopters and, when designed to and capable of accommodating, other rotorcraft or VTOL capable aircraft.
in the vicinity of a non-controlled aerodrome	An aircraft is in the vicinity of a non-controlled aerodrome if it is: <ol style="list-style-type: none"> a. in uncontrolled airspace; and b. within 10 nautical miles of the aerodrome; and c. at a height above the aerodrome that could result in conflict with operations at the aerodrome.
lighting segment	Lighting segments are low profile lighting fixtures that consists of a line of lighting elements within unit or frame.
obstacle	A fixed (whether temporarily or permanently) or mobile object, structure, or part of such objects and structures, that: <ol style="list-style-type: none"> a. is located on an area provided for the surface movement of aircraft; or b. extends above a defined surface designated to protect aircraft in flight; or c. stands outside the defined surfaces mentioned in paragraphs (a) and (b) and that have been assessed as being a hazard to air navigation.
obstacle limitation surfaces	<ol style="list-style-type: none"> 1. of an aerodrome, means: <ol style="list-style-type: none"> a. a surface associated with the aerodrome that is ascertained in accordance with the requirements prescribed by the Part 139 Manual of Standards for the purposes of this definition or 2. for a vertical flight facility, means: <ol style="list-style-type: none"> a. surfaces extending outwards and upwards from the FATO protection area (safety area) at angles compatible with the flight characteristics of the intended vertical flight aircraft, used to evaluate approach and take-off climb surfaces for clearance of obstacles.
performance class	For a stage of flight of a rotorcraft, has the meaning given by the Part 133 Manual of Standards.
remotely piloted aircraft	Has the same meaning as in Part 101 MOS.
rejected take-off area	A defined area on a heliport suitable for helicopters operating in performance class 1 to complete a rejected take-off.
runway-type FATO	A FATO having characteristics similar in shape to a runway <p>Note: A runway type FATO will most likely be associated with helicopter operating PC1 where the AFM (or the AOCs procedures) requires a rolling take-off with/or an aircraft's published rejected take-off distance that cannot be accommodated by a conventional (non-runway) FATO.</p>
stand	A defined area intended to accommodate vertical flight aircraft for purposes of loading or unloading passengers, mail or cargo; fuelling, parking or maintenance; and, where air taxiing operations are contemplated, the TLOF.
static load bearing surface	A surface capable of supporting the mass of an aircraft situated on it.

Term	Definition
strategically important helicopter landing site	Means an HLS declared by a state or territory to be of critical need to the provision of identified services, including: <ol style="list-style-type: none"> an HLS associated with a hospital; or an HLS provided with point-in-space (PinS) approach instrument flight procedures; or any other facility identified as strategic by State/Territory or Commonwealth government/authorities.
taxiway	A defined path on a heliport intended for the ground movement of vertical flight aircraft and that may be co-located with an air taxi-route to permit both ground and air taxiing.
taxi-route	A defined path established for the movement of vertical flight aircraft from one part of a heliport to another. <ol style="list-style-type: none"> Air taxi-route. A marked taxi-route intended for air taxiing. Ground taxi-route. A taxi-route centred on a taxiway.
touchdown and lift-off area (TLOF)	The surface over which the touchdown and lift-off is conducted. Note: A TLOF may be collocated with a FATO, or a stand.
touchdown positioning circle (TDPC)	A touchdown positioning marking in the form of a circle use for omnidirectional positioning in a TLOF.
touchdown/positioning marking (TDPM)	A marking or set of markings providing visual cues for the positioning of vertical flight aircraft.
touchdown/positioning (marking) shoulder line	A marking or set of markings providing visual cues for the positioning of vertical flight aircraft.
vertical flight aircraft	A helicopter or a VTOL capable aircraft and does not include an RPA.
vertical flight facility	An aerodrome facility provided for the movements of vertical flight aircraft.
vertical procedures	Take-off and landing procedures that include an initial and/or final vertical profile. The profile may or may not include a horizontal component.
VTOL capable aircraft (VCA)	A heavier-than-air aircraft, other than aeroplane or helicopter, capable of performing vertical procedures by means of more than two lift/thrust units.

Table 4: Definitions specifically related to the manoeuvring of helicopters and VTOL capable aircraft in relation to a vertical flight facility

Note: For this AC only, these terms, when describing the manoeuvring of vertical flight aircraft in relation to a vertical flight facility, have the following meaning.

Term	Meaning
touchdown	A manoeuvre whereby the aircraft's vertical momentum is arrested to a point where safe contact with the ground is made. In a purely vertical procedure, horizontal momentum will also be or has already been decreased to zero.
lift-off	A manoeuvre whereby the aircraft's vertical velocity becomes positive, and the aircraft safely leaves the ground. In a purely vertical procedure, horizontal momentum will remain at zero.

Term	Meaning
landing	A manoeuvre or manoeuvres that safely bring the aircraft from the landing decision point either to touchdown, where a TLOF is collocated with a FATO, or to a low hover, less than 10 feet, where a TLOF is not collocated with a FATO. The landing decision point is the last position from which a balked landing may be executed and beyond which the aircraft is committed to landing.
take-off	A manoeuvre or manoeuvres that safely bring the aircraft from either lift-off, where a TLOF is collocated with a FATO, or from a low hover, less than 10 feet, where a TLOF is not collocated with a FATO, to a height of 35 feet above the FATO, VPS and/or clearway and with a sufficient speed (VTOSS) to continue safe flight with a 35-foot clearance above any objects in the OLS area.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website <https://www.legislation.gov.au/>

Table 5: Legislation references

Document	Title
Part 91 of CASR	General Operating and Flight Rules
Part 133 of CASR	Australian air transport operations—rotorcraft
Part 139 of CASR	Aerodromes
Part 175 of CASR	Aeronautical information management
Part 91 MOS	Part 91 (General Operating and Flight Rules) Manual of Standards 2020
Part 101 MOS	Part 101 (Unmanned Aircraft and Rockets) Manual of Standards 2019
Part 133 MOS	Part 133 (Australian Air Transport Operations—Rotorcraft) Manual of Standards 2020
Part 139 MOS	Part 139 (Aerodromes) Manual of Standards 2019

Advisory material

CASA's advisory materials are available at <https://www.casa.gov.au/publications-and-resources/guidance-materials>

Table 6: Advisory material references

Document	Title
AC 1-01	Understanding the legislative framework
AC 91-16	Wake turbulence
AC 91-29	Guidelines for helicopters - suitable places to take-off and land
AC 133-01	Performance class operations
AC 139.R-01	Guidelines for heliports - Design and operation

Document	Title
AC 139.V-01	Guidelines for vertiport design

International Civil Aviation Organization documents

International Civil Aviation Organization (ICAO) documents are available for purchase from <http://store1.icao.int/>

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (<https://elibrary.icao.int/home>).

Table 7: ICAO references

Document	Title
ICAO Annex 14 Volume II	Annex 14 to the Convention on International Civil Aviation - Aerodromes - Volume II Heliports
ICAO Doc 9157	Aerodrome Design Manual
ICAO Doc 9261	Heliport Manual
ICAO Doc 10066	Aeronautical Information Management

International advisory material

Table 8: International advisory material

Document	Title
FAA AC 150/5390-2D	Heliport Design Hyperlink: https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document_current/documentnumber/150_5390-2
Helicopter Rotor Downwash Safety Guidebook	Preventing the Adverse Effects of Rotor Downwash. Director Générale de l'Aviation Civil (DGAC) France and French Aviation Safety Network Hyperlink: https://www.ecologie.gouv.fr/sites/default/files/guidance_material_helicopter_downwash.pdf
NFPA 418	National Fire Protection Association - Standards for Heliports and Vertiports
UK CAP 437	Standards for offshore helicopter landing areas. United Kingdom Civil Aviation Authority. Hyperlink: www.caa.co.uk/CAP437
UK CAP 1246	Standards for helicopter landing areas at hospitals. United Kingdom Civil Aviation Authority. Hyperlink: www.caa.co.uk/CAP1246
UK CAP 2576	Understanding the downwash/outwash characteristics of eVTOL aircraft. United Kingdom Civil Aviation Authority. Hyperlink: www.caa.co.uk/CAP2576
UK CAP 3075	Protecting the Future:

Document	Title
	Trials and Simulation of Downwash and Outwash for Helicopters and Powered Lift Aircraft Hyperlink: www.caa.co.uk/CAP3075

National Airports Safeguarding Framework principles and guidelines

National Airports Safeguarding Framework principles and guidelines are available at <https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/aviation-safety/aviation-environmental-issues/national-airports-safeguarding-framework/national-airports-safeguarding-framework-principles-and-guidelines>

Table 9: National Airports Safeguarding Framework principles and guidelines

Form number	Title
Guideline B	Managing the risk of building generated windshear and turbulence at airports
Guideline H	Protecting Strategically Important Helicopter Landing Sites

2 Introduction

2.1 Background

- 2.1.1 With the emergence of advanced air mobility (AAM) aircraft, aerodromes will shortly see new types of VTOL capable aircraft (VCA) operating at their facilities. When considering the introduction of new AAM aircraft at aerodromes designed to be used by aeroplanes, it became apparent that hazards and risks involving AAM aircraft are similarly applicable to helicopter operations.
- 2.1.2 This AC provides guidance for aerodrome operators on the recommended specifications and practices for the addition and integration of vertical flight facilities at an existing aerodrome that had previously only been designed for fixed wing aeroplanes. The AC will bring CASA's guidance up to date with the latest standards and recommended practices from ICAO and other aviation authorities around the world.
- 2.1.3 The AC may also provide additional options and considerations to aerodrome operators with existing helicopter operations when reviewing their current and future vertical flight operations.
- 2.1.4 It provides operators of aerodromes designed for aeroplanes with guidance for designing facilities for these emerging aircraft types while also providing a more detailed explanation and expansion of the helicopter markings guidance in Part 139 Manual of Standards (MOS). An accompanying general exemption¹ will allow for visual aids in this AC to be used in lieu of or in addition to those in the Part 139 MOS.
- 2.1.5 The guidance in this AC is applicable to all aerodrome sizes and can be scaled appropriately based on the complexity of the aerodrome and its current and future intended aircraft operations. The determination of what level of controls are applied, and when they should be applied, is an outcome of an aerodrome operator's safety/risk management processes.

Note: This AC should be read in conjunction with the Part 139 MOS, AC 139.R-01 Guidelines for heliports - design and operation, and AC 139.V -01 - Guidance for vertiport design. These documents provide supporting and/or detailed information for various sections throughout the AC.

- 2.1.6 The use of aerodromes designed for aeroplanes by vertical flight aircraft may include:
- common use of aerodrome facilities designed specifically using aerodrome reference code (for fixed wing aircraft) criteria
 - stand-alone vertical flight facilities on an aerodrome specifically designed by using vertical flight aircraft design criteria
 - shared use of runway to shared facilities or purpose-built facilities
 - dependent or independent use of runway and vertical flight aircraft only final approach and take-off facilities (FATO)
 - any combination of the above.

¹ At the time of publishing v1.0 of this AC, the exemption number and title had not been identified. This AC will be updated once the exemption is issued.

Notes:

1. It is not intended that aerodrome operators amend or upgrade aerodrome facilities to facilitate vertical flight aircraft, unless otherwise determined necessary through a hazard analysis or a risk assessment of existing or proposed vertical flight aircraft operations.
2. This AC does not include RPAS/drones in the definition of VCA or allow for RPAS/drone landing sites on an aerodrome.
3. This AC is not intended to limit or prescribe obligations on flight operations. Specifications that enable aerodrome operators to determine and publish aeronautical information should be developed through, and aligned with, the processes in the aerodrome’s safety management system. Accordingly, published information—such as recommended air-taxi and air-transit routes—is intended to support vertical flight aircraft pilots in operating within the aerodrome environment in a manner that avoids creating hazards to other aircraft, personnel and infrastructure, as they are required to do by regulations 91.055 and 91.375 of CASR, amongst other obligations. Such information can also assist air operators to meet their obligations regarding having procedures designed to ensure safe operations.

2.1.7 Vertical flight aircraft terminology

2.1.7.1 Due to the emerging nature of the AAM sector, internationally recognised terminology for AAM aircraft with VTOL capabilities has not been agreed upon. In AC 139.V-01, VTOL capable AAM aircraft are referred to as VTOL capable aircraft (VCA)². Accordingly, the acronym VCA has also been used in this AC when referencing these aircraft types.

2.1.7.2 However, this AC is intended to provide guidance on aerodrome facilities that can accommodate both helicopters and VCA. Given this, the term *vertical flight aircraft* will be used to mean **both** helicopters and VCA.



Figure 1: AW 139 helicopter at Karratha Airport (Image: CASA Media Library) and the Wisk Generation 6

(Image: Wisk)

² The term VCA aligns with EASA vertiport guidance, while the FAA currently use the term VTOL aircraft. This AC will be updated to align with ICAO once a definitive term is agreed upon.

2.2 Defining the operations

2.2.1 Intended vertical flight aircraft operations

2.2.1.1

Aerodrome operators should understand what the intended aircraft operations are for their aerodrome, including vertical flight capabilities. Intended aircraft operations refers to specific planned activities that aircraft will undertake while operating at a particular aerodrome. This includes details such as:

- a. Type of operating aircraft. The size and type of aircraft the facility will be used by (current or future use by fixed wing, helicopters or other rotary aircraft, other forms of aircraft, turbine, piston, electric or other forms of propulsion).
- b. Types of aircraft operations. The nature of flights (For example, take-off, landing, ground taxi, air-taxi, ground handling etc.).
- c. Classification of operations. Air transport (including passenger, cargo and medical transport operations), aerial work general and emergency service operations, private, training or itinerant.
- d. Flight schedules. Timetables for arrivals and departures, scheduled and unscheduled, of airlines and other aerodrome users.
- e. Manoeuvring area use. Designated runways, FATO's and associated landing sites and taxi paths for specific departure and arrival operations
- f. Weight and performance limitations. Adhering to the limitations advised by the aerodrome operator based on aircraft weight and performance characteristics to ensure safety.
- g. Relevant civil flight operations regulatory requirements. For example, Part 91 of CASR, including compliance with air traffic control (ATC) instructions.
- h. Safety protocols. Implementing safety measures for all operations involving aircraft and the aerodrome.

Note: Intended aircraft operations refers to the operational planning and logistics for aircraft activities at a specific location to ensure safety, efficiency, and adherence to aviation regulations.

2.2.2 Design vertical flight aircraft

2.2.2.1

The design vertical flight aircraft³ influences the physical characteristics and obstacle limitation surfaces for the vertical flight facilities.

2.2.2.2

The design vertical flight aircraft is a virtual aircraft composed of the most demanding physical and operational characteristics of all the intended vertical flight aircraft that currently or are expected to operate at the aerodrome including, but not limited to, the:

- largest set of dimensions, for example, D, rotor diameter (for helicopter)/maximum width (for VCA)
- greatest maximum take-off weight/mass (MTOW/MTOM)
- most critical flight path requirements, that is, approach/climb-out gradient and/or horizontal flight requirements following a critical failure.

³ AC 139.R and AC 139.V explain the concept of the design helicopter (for a heliport) and design aircraft (for a vertiport) respectively.

Note: For detailed explanation of the methodology behind the determination of the critical characteristics of the design aircraft concept refer to ICAO Doc 9261 Chapter 3 Appendix A.

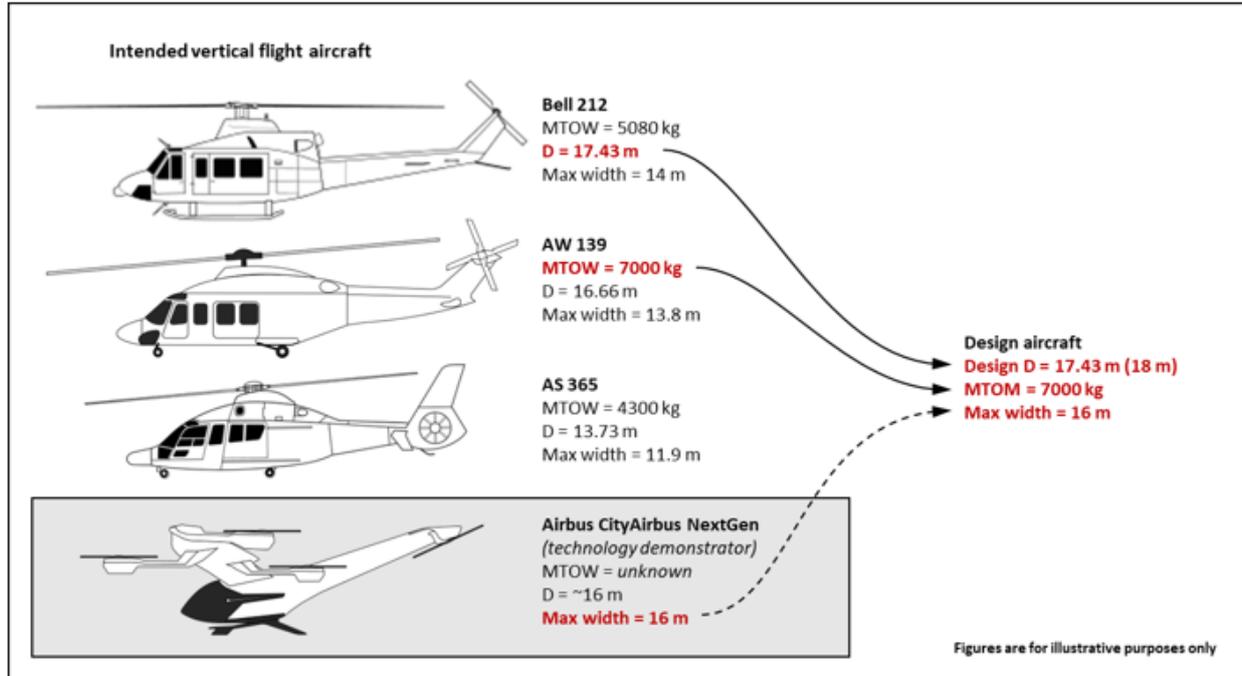


Figure 2: Compiling the design vertical flight aircraft data

(Source: CASA)

Determining design vertical flight aircraft (Figure 2)

The aerodrome operator determines the vertical flight aircraft with the largest D dimension, they intend to accommodate is a Bell 212 helicopter. A Bell 212 helicopter has a D of 17.43 m, therefore the design vertical flight aircraft has a (design) D of 17.43 m.

The heaviest vertical flight aircraft is determined to be a Leonardo AW139 at 7,000 kg (but which only has a D of 16.6 m) then the design vertical flight aircraft retains the D from the Bell 212 but has the MTOW of the AW139.

The addition of the CityAirbus NextGen (as an example VCA) which reportedly had a maximum width and D of approximately 16 m, would provide the design vertical flight aircraft with a maximum width of 16 m, while the design D would still be 17.43 m.

The AS 365, having a D, a width and a take-off weight less than the other 3 vertical flight aircraft does not influence these any of these 3 aspects of the design vertical flight aircraft specifications.

The aerodrome operator should consider all vertical flight aircraft to determine which may have the most critical flight path requirement.

Note: Additional considerations for design vertical flight aircraft may include undercarriage width, landing distance requirements, rejected take-off distance requirements and the impact of downwash and outwash (DW/OW) when vertical flight aircraft are landing, manoeuvring on the aerodrome or at take-off. Contingency planning for future larger aircraft should also be considered.

2.2.2.3 Where a VCA is operating with characteristics more consistent with fixed wing aeroplanes when at an aerodrome (such as a winged VCA ground taxiing using minimal thrust units) then existing facilities designed using the aerodrome reference codes, wingspan and outer main gear wheel span, may be applied for the operation of that aircraft.

2.2.3 Downwash and outwash

2.2.3.1 As the size of helicopters increases, the increasing DW/OW hazards have become a global safety concern. The potential for DW/OW from VCA is becoming understood as testing of these aircraft continues as part of their certification program. The hazards and risks vertical flight aircraft introduce during certain operations at facilities designed for aeroplanes may not have been sufficiently considered in an aerodrome context. Accordingly, the airborne movement of vertical flight aircraft over facilities designed for aircraft to ground manoeuvre may introduce unassessed risk.

2.2.3.2 The Australian Transport Safety Bureau (ATSB), and other foreign aviation investigation agencies, have recorded multiple incidents associated with DW/OW, many being associated with the increased operating weight of helicopters being used now in medical retrieval services.⁴

2.2.3.3 The hazards of DW/OW may vary significantly depending on:

- the operating weight of the aircraft
- rotor or propeller blade sizes, designs and rotational speeds
- the disk loading of the vertical flight aircraft
- the ambient temperature at the aerodrome
- the velocity and direction of ambient wind
- disruption to airflow caused by terrain, structures and buildings
- gradient of approach and departure paths flown by vertical flight aircraft.

VCA specific hazards

Research⁵ indicates that VCA, particularly those with high disk loading, may introduce more significant DW/OW hazards than the DW/OW hazards of helicopters of comparable size and weight. Single rotor helicopters produce a, generally, radial DW/OW footprint. VCA DW/OW footprints vary greatly with the number and spacing of the lift/thrust units.

The different proximity between adjacent lift/thrust units can create hazardous phenomena such dynamic wake interactions and vortex bullets (where multiple tip vortices combine and become unstable) that travel randomly through, and beyond, the normal outwash area.

⁴ ATSB Transport Safety Report AD-2022-001 - Safety risks from rotor wash at hospital helicopter landing sites – 27 September 2023 (see <https://www.atsb.gov.au/sites/default/files/2023-09/AD-2022-001-Final.pdf>)

⁵ Powered-Lift Downwash Safety Manual (David Ison, PHD) - 2025

[Helicopter Downdraft Danger](#). (BP Video produced by BP)

'The video explains the dangers of helicopter downdraft when a helicopter is near an offshore installation. It shows the areas most affected by downdraft and provides steps that installations can take to reduce the risks during helicopter arrivals and departures. Following these steps helps make helicopter operations safer and minimizes potential dangers.'

Transcript available in the video.

- 2.2.3.4 When selecting the location for any vertical flight facility on an aerodrome, the operator or designer should assess the DW/OW hazards associated with each aircraft type expected to operate and, as far as practicable, ensure the facility's siting and design mitigate those risks. Where the assessed risk cannot be reduced by the location and design alone then a protection zone that is appropriate to the design vertical flight aircraft should be considered.
- 2.2.3.5 Section 2.2.3 of AC 139.R-01 and AC 139.V-01 have specifications on DW/OW and considerations as they relate to heliports and vertiports respectively. The specifications in both ACs are equally applicable to vertical flight facilities on an aerodrome.
- 2.2.3.6 AC 139.R-01 introduced the concept of the downwash and outwash protection zone (DPZ). Areas that have been risk assessed as requiring a DPZ (such as the area around FATOs and under flight paths) should have controls put in place to ensure that risk to persons and property is reduced to an acceptable level.
- 2.2.3.7 Controls within a DPZ may include but are not limited to:
- temporary or permanent barriers or ground markings
 - procedural restrictions of ground operations during flight operations
 - procedural controls of FOD, materials, vehicles and equipment within the DPZ.
- 2.2.3.8 When determining the DPZ aerodrome operators should recognize that, in addition to the hover over the FATO, DW/OW will be prevalent during the final approach to the hover as well as, the initial lift-off, and whenever the vertical flight aircraft is positioning to, or away from, the FATO.
- 2.2.3.9 The area(s) that should be assessed for requiring a DPZ being at least:
- the area 3 x the max width (of the design vertical flight aircraft with the most critical DWOW risk⁶) around the FATO (measured from the edge of the FATO) see Figure 3.
 - the area within 3 x the max width laterally of the vertical flight aircraft approach and departure tracks
 - any other areas that may be affected, such as taxi routes and vertical flight aircraft training areas.

⁶ Determined by the data in Table 1 in Appendix A of AC 139.R-01. This table is not exhaustive so similar data provided by the aircraft manufacturer, ICAO or other State civil aviation authorities should also be considered.

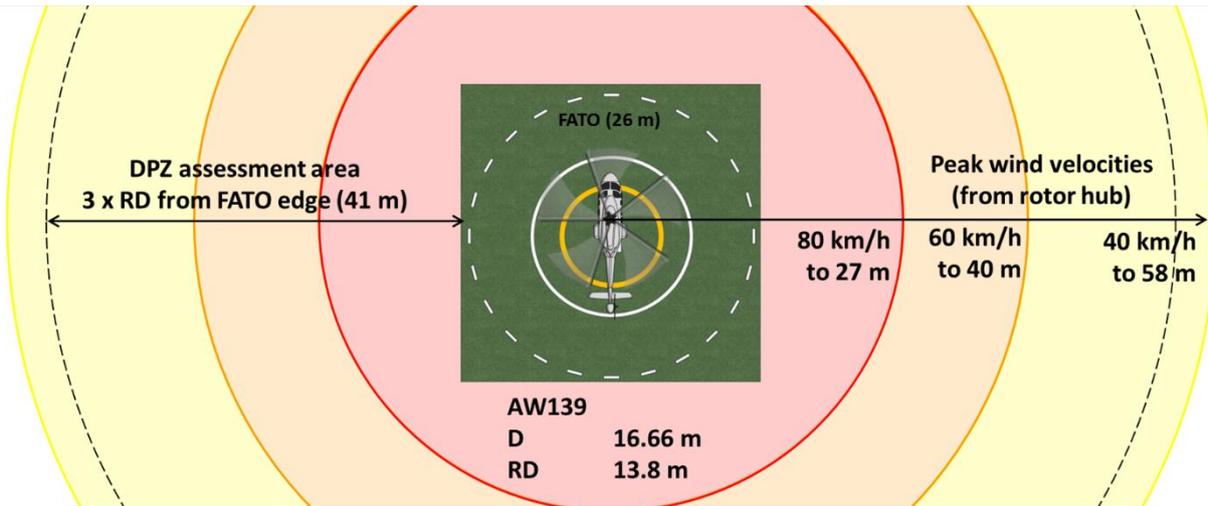


Figure 3: DPZ assessment area versus the peak wind velocity data for a AW139. The max width of the AW139 being its rotor diameter

(Source: CASA)

Notes:

1. ICAO Doc 9261 (sixth edition and later versions) provides guidance information on the maximum DW/OW velocities as concluded by Ferguson, 'Rotorwash Operations Footprint Modelling'. This data is included in AC 139.R-01. All diagrams illustrating peak wind velocities in this AC are based on this data.

The UK CAA CAP 3075⁷ (April 2025) builds on industry's understanding of downwash and outwash highlighting that the effects of DW/OW should not be thought of as a constant air flow at any single point. But is instead a turbulent, buffeting and unpredictable movement of air with the potential for sudden changes in speed and direction of air flow.

Powered-Lift Downwash Safety Manual (Ison, D. 2025) adds research detail on DWOW hazards for VCA such as greater downwash velocities of VCA with high disk loading and multirotor vortex interactions.

2. This AC does not provide a "universal safe" wind speed limit on DW/OW. A wind speed that may be considered safe and acceptable at one aerodrome cannot be applied to all aerodromes, nor can it be applied to all the facilities at the same aerodrome. The required outcome is for operator to provide safe vertical flight facilities that consider the hazard of DW/OW.

DW/OW risk should be assessed by the aerodrome operator (and by aircraft operators) through their safety/risk management systems. The risk assessment should consider all variables from (but not limited to) current and future aircraft operations, facility design, layout and marking, local weather patterns and the demographics of passengers, visitors and staff.

Aerodrome specific downwash and outwash considerations

- 2.2.3.10 Aerodrome operators should consider the DW/OW hazards of their intended vertical flight aircraft operations during all phases of flight operations within and around the aerodrome including:

⁷ CAP 3075 - Protecting the Future: Trials and Simulation of Downwash and Outwash for Helicopters and Powered Lift Aircraft. www.caa.co.uk/CAP3075

- approach and climb-out manoeuvres
- liftoff and touch down within a FATO/TLOF, a stand or on an apron
- ground taxiing
- air-taxiing, air transit.

Approach and climb-out manoeuvres

- 2.2.3.11 Approach and climb-out paths should be considered as they relate to the layout of facilities within the aerodrome. Approach and climb-out paths that pass over taxiways, taxi lanes or aprons could pose a DW/OW hazard to aircraft or vehicles on the ground or personnel on the aprons.
- 2.2.3.12 Aerodrome operators should also consider the impact of approach and climb-out paths that cross the aerodrome boundary and their impact on non-aeronautical facilities, people and publicly accessible areas.

Liftoff and touch down within a FATO/TLOF, a stand or on an apron

- 2.2.3.13 When vertical flight aircraft lift-off and touchdown, they require a large amount of power to decelerate to the hover and hover or to become airborne, establish a hover and manoeuvre for taxi or departure.

Ground taxiing

- 2.2.3.14 Helicopters, with wheeled undercarriages, capable of ground taxiing, create significantly less DW/OW when ground taxiing compared to if they are air-taxiing and should be capable of ground taxiing on a taxiway with a taxiway strip code consistent with the helicopter's rotor width.

Air taxiing

- 2.2.3.15 Skid-equipped helicopters, being unable to ground taxi, will have no option but to either air-taxi or air transit between a FATO and parking position. Aerodrome operators should consult with helicopter operators (and air traffic service providers where applicable) to determine air taxi and air transit routes around the aerodrome that pose the least DW/OW risk to facilities, aircraft, vehicles and persons. Refer to paragraph 6.1.5 of this AC for publishing air taxi routes.
- 2.2.3.16 Air-taxi routes above apron taxilanes, directly over light aircraft parking or areas where people may congregate needs to be avoided.
- 2.2.3.17 Air taxi routes, where a helicopter remains in ground effect, can present a DW/OW hazard to adjacent facilities including but not limited to runways or aprons. Figures 4 and 5 illustrate helicopters air-taxiing over a taxiway with the potential peak air velocities overlaid.

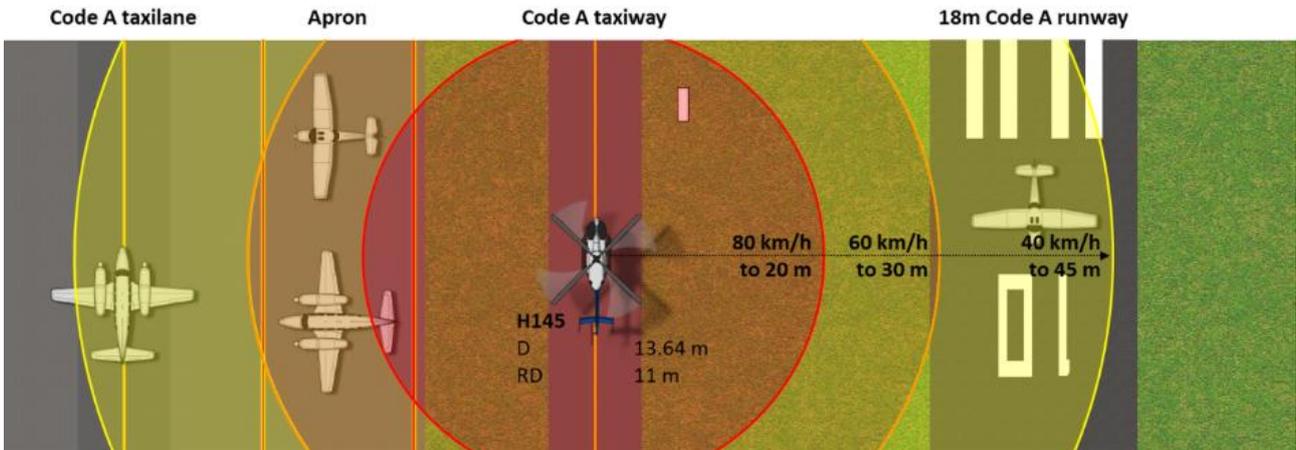


Figure 4: H145 peak wind velocities vs code A separations

(Source: CASA)

2.2.3.18 Figure 4 shows an at scale overlay of potential peak wind velocities of a H145 helicopter air-taxiing along a code A taxiway with aprons and a code A runway at minimum separation distances as per Part 139 MOS.

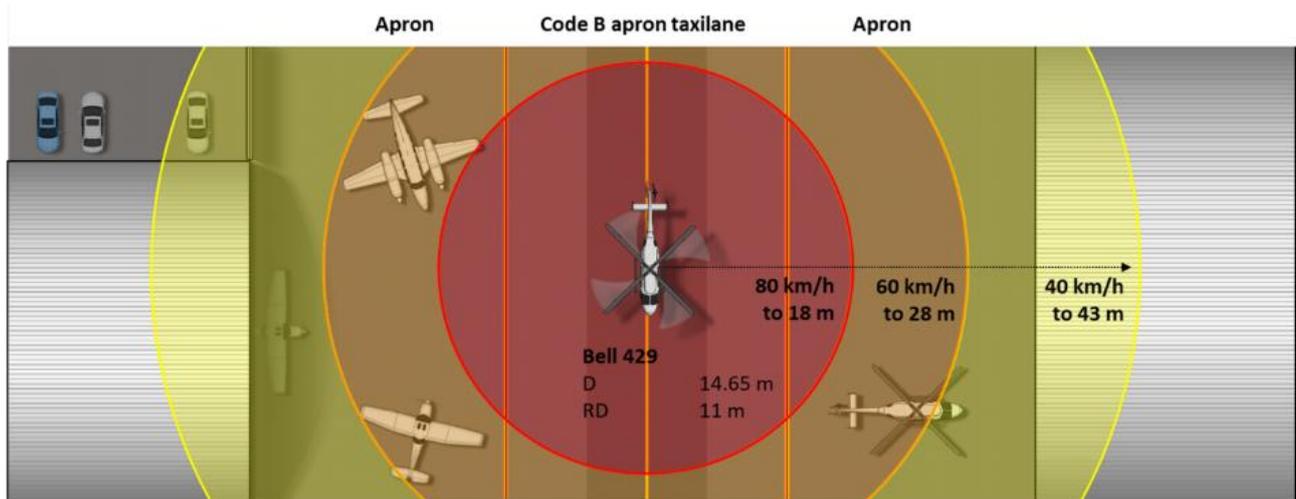


Figure 5: Bell 429 peak wind velocities vs code B separations

(Source: CASA)

2.2.3.19 Figure 5 shows an overlay of potential peak wind velocities of a Bell 429 helicopter air-taxiing along a code B taxilane with aprons minimum separation distances as per Part 139 MOS.

Note: Figure 4 and Figure 5 show the potential peak wind velocities while in ground effect based on the data as published in AC 139.R-01. This suggests that, in both scenarios, aircraft parked on the aprons may be subject to peak wind velocities up to 80 km/h, and in Figure 4, that an aircraft on a parallel code A runway could be subject to wind velocities of 40 km/h or more. (see also notes for Figure 3)

2.3 Arrival and departure procedures

- 2.3.1 Regulation 91.375 of CASR requires that aircraft in the vicinity of a non-controlled aerodrome⁸ must join, or avoid, the circuit pattern. Helicopters can either join the standard aeroplane circuit pattern or join the circuit area from any direction, at 500 ft above the surface, and descend to land or take-off from any location the pilot assesses as suitable⁹.
- 2.3.2 The operator of an aerodrome has a responsibility for safety considerations on their aerodrome. As such an aerodrome operator may not wish for helicopter pilots to approach, taxi and land or take-off at their own discretion.
- 2.3.3 Part 175 (through the AIS provider) requires an aerodrome operator to publish aerodrome charts that include coordinates and directions for FATOs, ground and air taxiways, air transit routes, and local traffic regulations determined by the aerodrome operator that relate to the safe use of the aerodrome.
- 2.3.4 Where appropriate, and in consultation with air traffic services at controlled aerodromes, an aerodrome operator may influence the preferred arrival, departure, approach, take-off and ground-maneuvring paths of vertical flight aircraft through the design, location and alignment of FATO facilities. In the same way
- 2.3.5 Local traffic regulations may require vertical flight aircraft to join the runway in use following the standard traffic pattern or alternative arrangements, such as to a taxiway or taxiway intersection parallel the traffic pattern, or to a standalone FATO.
- 2.3.6 Aerodrome operators in consultation with aircraft operators and air traffic services, should conduct a risk assessment¹⁰ in accordance with their safety/risk management system before considering the option of vertical flight aircraft operations that would have a different or modified traffic pattern compared to the established generic procedures for vertical flight aircraft operations.

Caution: Helicopter wake turbulence

DW/OW hazards are generally related to helicopters hovering or moving at relatively slow speeds, nominally less than 15 kts.

However, at ground speeds greater than effective transitional lift, usually 16-20 kts, DW/OW effects trail the helicopter and presents as wake turbulence vortices with potentially significant effects on aircraft adjacent to the helicopter flightpath track and following the helicopter.

The VAI (formally the HAI) and the FAA recommend that fixed wing aircraft pilots and operators recognise this risk and adopt the 3-3-2 separation rule when interacting with helicopter operations, regardless of helicopter mass:

- 3 rotor diameters lateral separation at hover.
- 3 nautical miles trailing separation.
- 2 minutes wait time separation.

⁸ 'in the vicinity of a non-controlled aerodrome' is a defined phrase - see regulation 91.360 of CASR.

⁹ As of the publication of this AC, see AIP ENR 1.1 section 10.15 Helicopter Operations - At Aerodromes and Helicopter Access Corridors and Lanes.

¹⁰ Appendix D of AC 139.R-01 provides details on airspace hazard safety assessments a form of risk assessment that

<Caution! Helicopter Wake Turbulence (The Rotorcraft Collective)> a YouTube video by the FAA
 "Helicopters can generate wake turbulence that is equally as hazardous as fixed-wing aircraft. You should avoid operating aircraft within three rotor diameters of any helicopter in a slow hover taxi or stationary hover and use caution when operating behind or crossing the path of a landing and departing helicopter. Watch this video for more tips on avoiding helicopter wake turbulence."
 Transcript available in the video.

2.3.7 Simultaneous landing and/or take-off operations - helicopters

- 2.3.7.1 Where there are simultaneous operations, between helicopters and other aircraft, a helicopter will generate significantly more wake turbulence than a fixed wing aircraft of the same weight.
- 2.3.7.2 For simultaneous use, a non-instrument runway and non-instrument FATO, the minimum separation distance between the runway centreline and FATO centre (or extended centreline) should be as described in Table 10 below.

Table 10: Recommended separation distances between non-instrument FATO and runway centrelines for simultaneous operations

Aeroplane size	Small Helicopter ≤ 3175 kg	Medium Helicopter 3176 kg – 5700 kg	Large Helicopter > 5700 kg
Small aeroplane ≤ 5700 kg	90 m	150 m	210 m
Large aeroplane 5700 kg – 100 000 kg	150 m	150 m	210 m
Heavy aeroplane > 100 000 kg	210 m	210 m	210 m

2.3.8 Non-simultaneous landing and/or take-off operations - helicopters

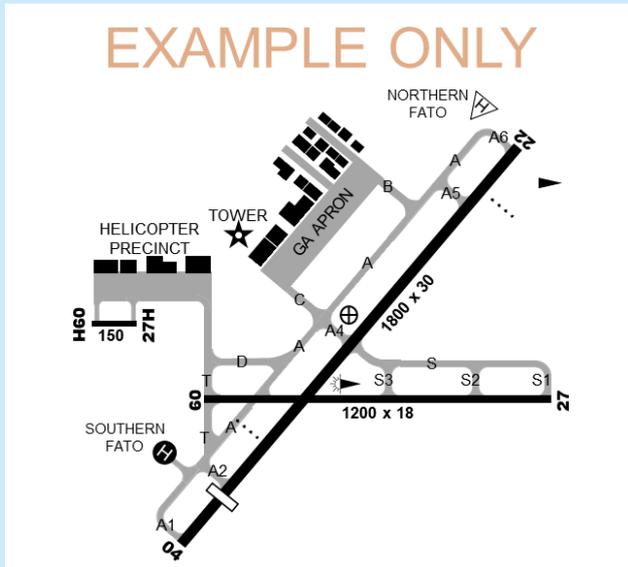
- 2.3.8.1 Where existing FATOs and runways are located less than the above recommended separation distance, simultaneous operations between the FATO and runway should not be permitted.
- 2.3.8.2 At an uncontrolled aerodrome where medium and large helicopters and LIGHT¹¹ wake turbulence category aircraft (7,000 kg or less) are arriving to FATOs and runways located less than the above recommended distance, aerodrome operators should consider providing published information advising LIGHT category aircraft of the helicopter wake turbulence hazard.
- 2.3.8.3 Aerodrome operators should consider that pilots of LIGHT wake turbulence category aircraft may not be aware that a preceding helicopter may pose a wake turbulence hazard.

¹¹ A LIGHT turbulence category refers to aircraft types with and MTOW of 7 000 or less. Further details on wake turbulence and wake turbulence categories can be found in AC 91-16 on the CASA website.

Example:

For the fictional aerodrome depicted, where approaches to RWY 22 and the northern FATO are separated by less than 210 m, the ERSA entries might read:

Aircraft 7000 kg and below arriving RWY 22 behind a helicopter arriving to northern FATO, caution helicopter wake turbulence.



Note: ATC services are not required to provide a wake turbulence separation standard between LIGHT category aircraft and helicopters less than 7000 kg MTOW.

If an aerodrome, with ATC tower services, is concerned about helicopter wake turbulence separation standards not being provided between helicopters 7000 kg and below and LIGHT category aircraft, then this would have to be a discussion that the aerodrome would have to have with Airservices Australia.

2.3.9 Simultaneous landing and/or take-off operations - VCA

Reserved.

2.3.10 Non-simultaneous landing and/or take-off operations - VCA

Reserved.

3 Physical characteristics of aerodrome vertical flight facilities

3.1 General

- 3.1.1 The physical facilities that vertical flight aircraft use may be runways, taxiways, and aprons that have been designed and provided for aeroplanes. However, an aerodrome operator may choose to design and build facilities on their aerodrome specifically for vertical flight aircraft.
- 3.1.2 Vertical flight aircraft may be integrated with aeroplanes on some facilities and segregated from aeroplanes on other facilities.
- 3.1.3 These specific facilities may include:
- one or more final approach and touchdown areas (FATO)
 - one or more touch down and lift-off areas (TLOF)
 - FATO protection areas
 - taxiways and/or taxi-routes
 - stands (and associated protection areas).

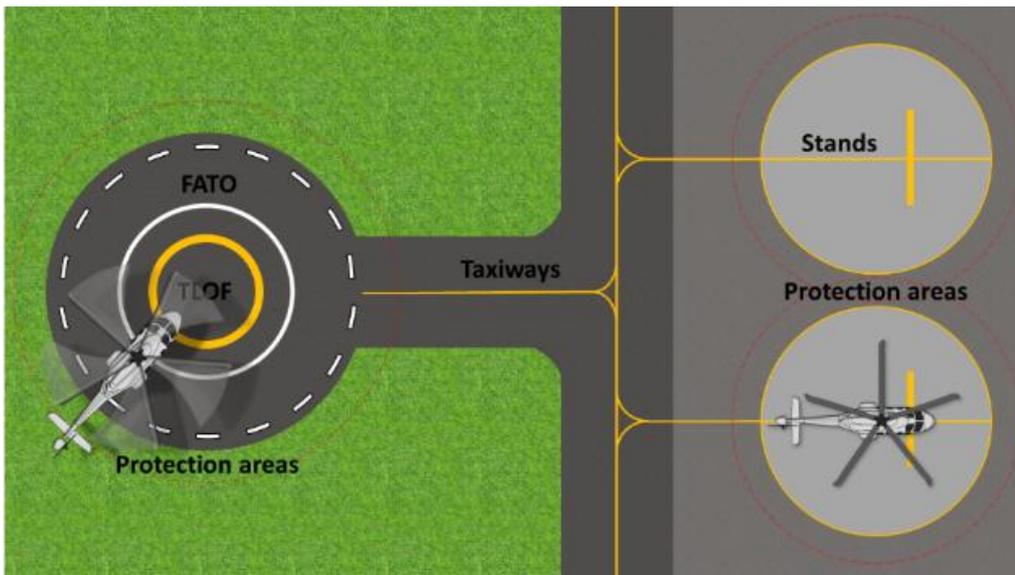


Figure 6: Example of facilities that may be required for vertical flight operations at an aerodrome

(Source: CASA)

3.1.4 Design consultation

- 3.1.4.1 Aerodrome operators and aerodrome designers should design vertical flight facilities in consultation with relevant stakeholders. The design development should include a consultation with relevant stakeholders throughout the life of the project, such as but not limited to:
- CASA
 - Airservices Australia
 - aircraft operators (both fixed wing and vertical flight operators)

- vertical flight aircraft original equipment manufacturers (OEM)
- local governments
- State, territory and federal government agencies

3.2 Physical facilities

- 3.2.1 The FATO, the TLOF, the FATO protection areas and the touchdown positioning marking (within the TLOF) each have a defined purpose and as such interact with each other in a particular way.
- 3.2.2 Each of the defined areas has a set of attributes and minimum dimensions which permit freedom of location alongside, or collocation with other defined areas. Each defined area is completely self-contained; they can be used in any combination without breaching their integrity.

FATO

- 3.2.3 The purpose of the FATO is to provide an area that will safely contain the whole vertical flight aircraft during the final moments of the approach to hover and the initial take-off manoeuvres from hover. Where the FATO is to provide for rejected take-off then the FATO should provide a surface capable of supporting and containing an aircraft, performing a rejected take-off, until it comes to a stop.

TLOF

- 3.2.4 The TLOFs purpose is to provide a dynamic load bearing area that will safely contain the undercarriage (wheeled or skid-equipped) of a vertical flight aircraft during touch down and lift-off manoeuvres.

FATO protection area (safety area)

- 3.2.5 The FATO protection area (FPA) provides an area clear of obstacles (other than essential navigation aids). The FPA provides an area to protect against the risk of obstacle intrusion that may affect the safe operation of aircraft where the vertical flight aircraft deviates from the bounds of the FATO during approach, take-off or hover.
- 3.2.6 The purpose of the FATO protection area is to protect the aircraft and its operation. The FATO protection area is not intended to protect people and equipment from the effect of the aircraft or its operation.

The touchdown positioning marking

- 3.2.7 The facility that ties the others together is the touchdown positioning marking (TDPM). The TDPM is provided to give the pilot of vertical flight aircraft guidance to accurately and safely touch down. Touching down with the pilot's seat over the TDPM ensures the aircraft undercarriage is located safely within the TLOF and the whole aircraft is positioned within the FATO or aircraft stand and clear of adjacent obstacles.

3.3 Final approach and take-off area

- 3.3.1 An aerodrome that has vertical flight operations should have at least one location nominated to serve as the FATO area.
- 3.3.2 A FATO at an aerodrome may be a runway, a nominated taxiway or taxiway intersection or a purpose-built facility.

3.4 Nominating a runway or taxiway as a FATO

3.4.1 When a runway or taxiway is nominated as a FATO, aerodrome operators should consider the additional specifications for a FATO outlined in section 3.1 of AC 139.R-01, such as but not limited to:

- being free of obstacles
- resistant to the effects of DW/OW generation by the aircraft
- have the pavement strength capable of withstanding the intended (if provided with a TLOF) and unintended (to contain a rejected take off or forced landing) landing forces
- be of a length and width appropriate to the performance class of the intended aircraft operation
- have an associated protection area.



Figure 7: Robinson helicopter approaching Runway 29C at Bankstown Airport

(Source: CASA)

3.4.2 Where a taxiway intersection is nominated as a FATO the approach and departure paths available to that FATO should, where practicable, be considered so that an approaching or departing vertical flight aircraft does not need to over fly aircraft that may be on nearby taxiways. Refer Figure 8.

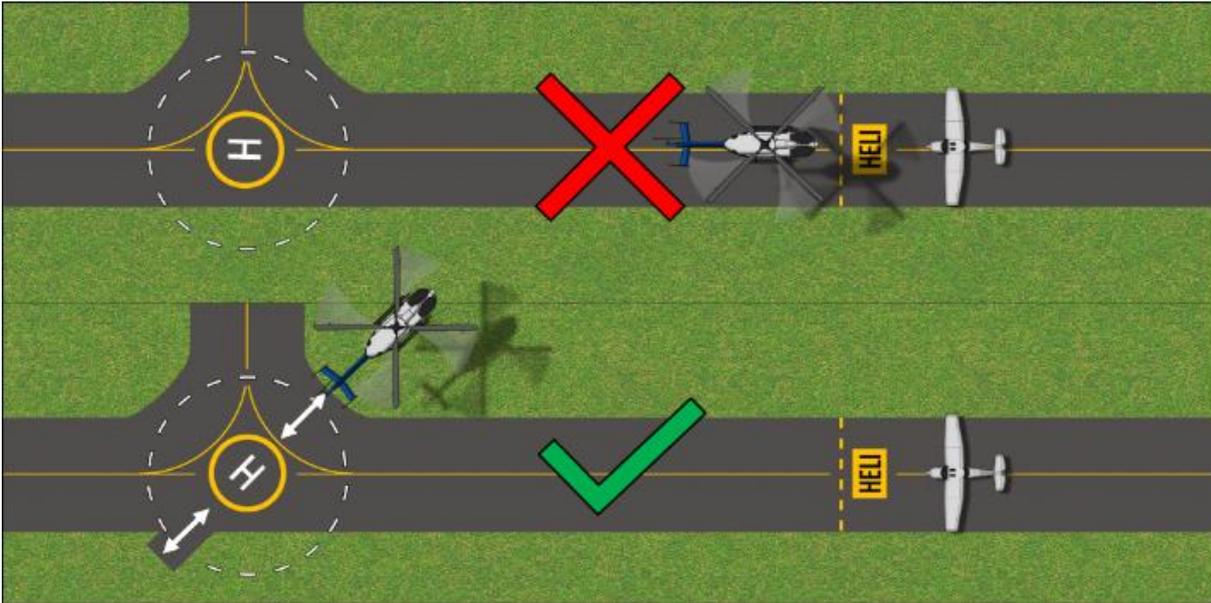


Figure 8: Alignment of approach and departure paths for a taxiway FATO to deconflict with other traffic on the taxiway

(Source: CASA)

3.4.3 Standalone FATO/s

- 3.4.3.1 If an aerodrome wishes to have a FATO (or multiple FATOs) that are separate facility(s) for the exclusive use of vertical flight aircraft, then there are 2 types of FATOs that may be considered. A runway type or a conventional (non-runway) type.
- 3.4.3.2 The size of the FATO is usually determined by the length (and width) of the rejected take-off distance required (RTODR) by the aircraft operator, where provided for and the design vertical flight aircraft which is the most demanding helicopter or VCA intended to operate at the aerodrome.
- 3.4.3.3 Whilst LDAH should be included in published information it is generally a lesser distance than the RTODR as such is not the defining distance for design of a FATO.

Runway type FATO

- 3.4.3.4 Where the runway cannot be used as a FATO, and a vertical flight aircraft operator requires their aircraft to perform a rolling take-off manoeuvre, or where the aircraft has a requirement for a longer RTODR than can be accommodated by an elongated FATO, the aerodrome operator may choose to provide a runway type FATO.

Note: From a design and marking perspective, once the length of a FATO is greater than 5 times its width then a runway type FATO should be considered. The broken perimeter markings and the 'H' designation for a runway type FATO is intended to be a visual indication for a fixed wing pilot not to mistake it for a fixed-wing runway.

- 3.4.3.5 A runway type FATO should be designed to meet the specifications as outlined in section 3.1 of AC 139.R-01.

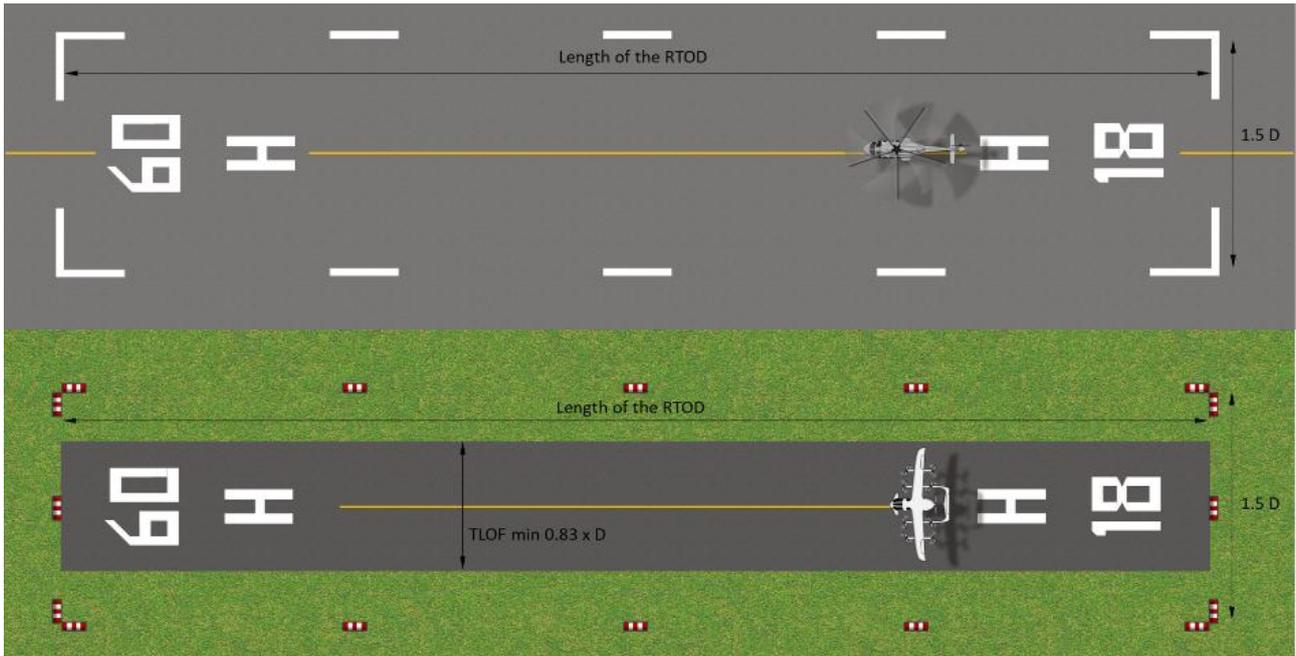


Figure 9: Runway type FATO examples

(Source: CASA)

3.4.3.6 Figure 9 shows 2 examples of runway type FATOs. One co-located with an existing taxiway centreline, the other being a standalone facility with a grass FATO and paved TLOF.

Conventional FATO

3.4.3.7 The minimum dimensions of the FATO should be at least 1.5 x Design D or the length and width specified by the AFM for the design vertical flight aircraft.

Note: Refer to section 3.1 AC 139.R-01 for specifications on FATO design, and Doc 9261 for detailed explanation of the derivation of the figures used for facility design.

3.4.3.8 Table 11, below, is a general guide to FATO sizes and the helicopters and VCAs able to be accommodated on it, using the 1.5 x design D calculation. Vertical flight aircraft smaller than the design aircraft can use larger sized FATOs

3.4.3.9 Also included in the table are the associated TLOF dimensions (both as min 0.83 x D and a simplified 1 x D) where a TLOF is included.

Note: The certification requirements of individual aircraft and the way the aircraft are operated may vary the size of the FATO and associated TLOF. Certification requirements of individual helicopters and VCA intended to use the FATO that require a different size facilities greater than 1.5 x D should be considered.

Table 11: Size requirements of conventional (non-runway type) FATO?

Diameter FATO being provided	Largest vertical flight aircraft that can be accommodated	Maximum D value	Associated TLOF. 0.83 x Design D (1 x D) ¹²
18 m	R22, R44, R66, Bo105, Volocopter Velocity	12 m	10 m (12 m)
23 m	Bell 407, H125, H145, AW169, Joby S4	15 m	12.5 m (15 m)
26 m	Bell 430, H160, S-76D, AW 139, Most current VCAs ¹³	17 m	14.2 m (17 m)
33 m	Bell 412 and 212, H225, Bell 525, UH-60, S-92A.	22 m	18.5 m (22 m)
41 m	AW101, S-64E	27 m	22.5 m (27 m)

3.5 Aiming point or TLOF

- 3.5.1 The aerodrome operator should determine the intended operation to and from the FATO(s). The aerodrome operator should determine if the intended operation for the vertical flight aircraft is to touch down within the FATO, or alternatively, to approach to hover over the FATO then transition to an air-taxi or air transit to a TLOF, stand or apron elsewhere on the aerodrome.
- 3.5.2 Where an aerodrome operator permits vertical flight aircraft to touch down within the FATO, the FATO should contain a touchdown and lift-off area (TLOF) with relevant visual aids for a TLOF, including a TDPM.
- 3.5.3 Where a touch down within the FATO is not permitted, the FATO should contain an aiming point indicated by the relevant visual aids.

Note: Section 5 of this AC will cover the correct markings to be used for FATOs, TLOFs and aiming points.

3.5.4 Touch down and lift-off area

- 3.5.4.1 A touch down and lift-off area (TLOF) should meet the specifications for a TLOF outlined in section 3.1 of AC 139.R-01, such as but not limited to:
 - being free of obstacles
 - have the bearing strength capable of withstanding the intended (and unintended) landing forces
 - resistant to effects of DW/OW generated by the aircraft
 - have sufficient friction to avoid skidding.

¹² Rounding up to 1 x D can make calculations easier. 1 x D TLOF is also used in guidance for elevated and offshore helidecks and in the FAA Vertiport Engineering Brief 105A.

¹³ Data on 11 leading VCA aircraft provided to ICAOs Vertical Flight Infrastructure Working Group by OEMs (2024) shows that a Design vertical flight aircraft derived from these aircraft would have a D of 16.9 m.

- 3.5.4.2 The minimum size for a TLOF should be at least 0.83 x design D, or sized to sufficiently contain the undercarriage of the design vertical flight aircraft.

Note: Emerging research indicates a TLOF of a minimum of 1 x design D may be recommended for VCA operations. Aerodrome operators should consider a larger TLOF if intending to cater for VCA operations.

- 3.5.4.3 Aerodromes with natural surface TLOFs (or stands) may consider the use of ground surface reinforcement such as, grid type products to improve the bearing strength, surface friction characteristics and drainage of natural surface TLOFs where a paved surface is not viable or desired.

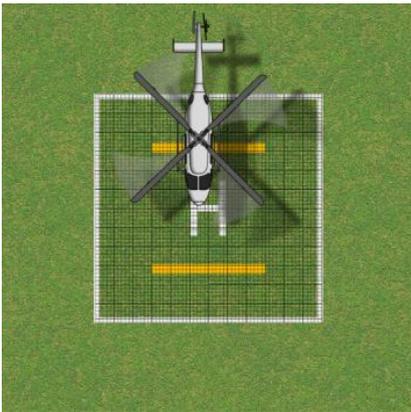


Figure 10: Ground surface reinforcement of TLOFs

(Source: CASA)

- 3.5.4.4 Figure 10 shows an example of a grass TLOF that has had grass reinforcing grid product installed to help improve the bearing strength of the natural surface.
- 3.5.4.5 Ground surface reinforcement products should be installed and maintained so they will not lift or move under the maximum downwash or dynamic loading of the design vertical flight aircraft.

3.6 Nominating taxi-routes and transit routes

- 3.6.1.1 Aerodrome operators that accommodate vertical flight aircraft, have 3 options for the paths along which vertical flight aircraft will manoeuvre. These are:
1. ground taxi-routes
 2. air taxi-routes
- or
3. air transit routes.
- 3.6.1.2 Aerodrome operators may nominate taxiways on the aerodrome that are or are not available for vertical flight aircraft to taxi on.
- 3.6.1.3 These nominated taxi routes should be part of an aerodrome's published aerodrome charts and should be included in the aerodrome manual.
- 3.6.1.4 The aerodrome operator may choose to nominate aerodrome facilities for vertical flight aircraft due to the mitigation or elimination of potential hazards and risks specific to the intended operation of the aircraft.

3.6.2 Ground taxi-routes

- 3.6.2.1 Vertical flight aircraft with wheeled undercarriage may ground taxi. Similar to a propellor driven aircraft, once the aircraft is moving it requires little energy to maintain a ground taxi, as such the DW/OW effects are lessened.
- 3.6.2.2 Centred on a taxiway, a ground taxi-routes for vertical flight aircraft should be no less than of 1.5 times the overall width of the design vertical flight aircraft.
- 3.6.2.3 Despite paragraph 3.6.2.2, for a VCA that has a different configuration for taxiing, such as having their outboard lift/thrust units unpowered or folded/stowed and publish a separate dimension for taxiing ($D_{taxiing}$), then that dimension may be used instead of maximum width.
- 3.6.2.4 The maximum width of the helicopter or VCA as mentioned in 3.6.2.2 should not exceed the permitted (fixed) wingspan for the taxiway or taxilane code.

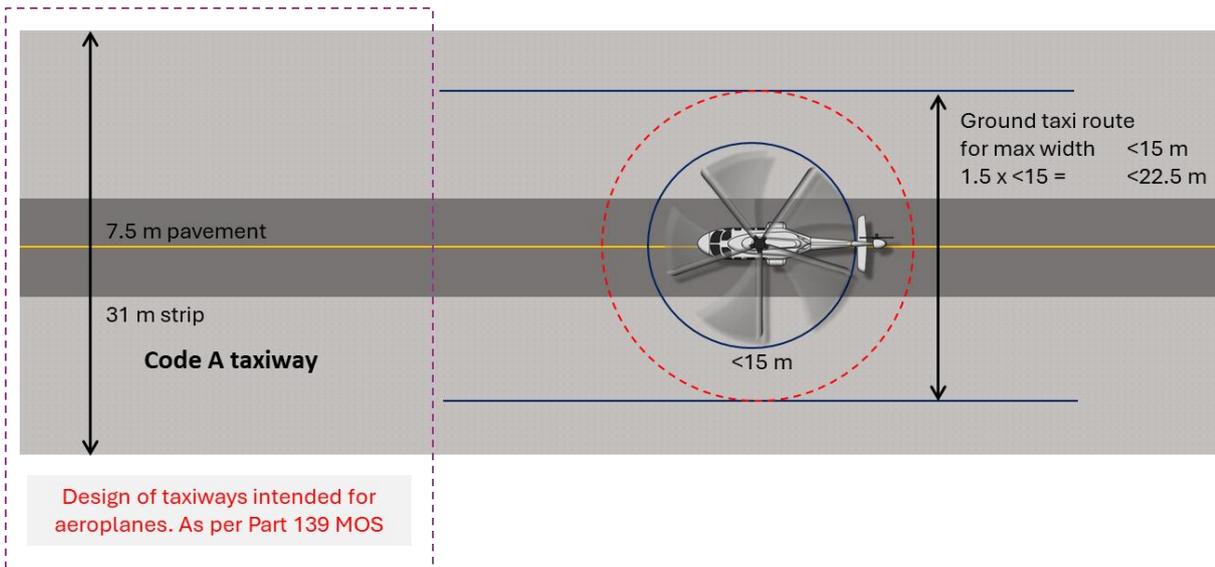


Figure 11: Illustration of a code A taxiway and taxiway strip vs the ground taxi route width for a helicopter of <15 m

(Source: CASA)

- 3.6.3 Table 12 shows the relationship between taxiway and taxilane strip widths and the corresponding rotor widths that would contain the ground taxi-route requirements for vertical flight aircraft.

Table 12: Taxiway code strips vs ground-taxi route limitations

Taxiway/taxilane Code	Code A taxiway	Code B taxiway	Code A taxilane	Code B taxilane
Strip width (m)	31	40	24	33
Max. permitted wingspan (m) ¹⁴	<15	<24	<15	<24
Maximum overall width ¹⁵ for a ground taxiing helicopter or VCA (m)	<15	<24	<15	<24

¹⁴ As per Part 139 MOS Table 4.01 (4) ARC letter

¹⁵ Overall width or rotor diameter.

- 3.6.3.1 While outwash is considerably less for a ground taxiing helicopter than for an air-taxiing one, the effects of outwash hazards on, people, equipment and structures should be still be considered. This is especially important where the outwash effects may extend beyond the boundary of the aerodrome, where non-aerodrome activities may be impacted by the hazard.
- 3.6.3.2 VCA operators may be required to tow their aircraft in lieu of taxi due to energy conservation needs. This might be from or to the FATO or TLOF or perhaps a taxiway close to a hanger or apron. Aircraft under tow are not subject to the lateral clearances mentioned above.
- 3.6.3.3 VCA and helicopter operators are recommended to liaise with aerodrome operators in relation to the towing of their aircraft.
- 3.6.3.4 Aerodrome operators should risk assess the towing routes for helicopters and VCA to ensure appropriate pavement widths and obstacle clearance for the towing equipment and other aircraft.



Figure 12: AW 139 helicopter ground taxiing, Karratha Airport

(Source: CASA)

- 3.6.3.5 Where aircraft operators intend to land, take-off or move their aircraft on mobile platforms, the aerodrome operator should obtain a copy of the safety assessment from the aircraft operators use of the mobile platforms and ensure that the hazards and risks to other aerodrome users have been appropriately considered.

3.6.4 Air taxi routes

- 3.6.4.1 Air taxi routes allow for helicopter movements at a height not more than 2 rotor diameters above the ground and at a speed less than 20 kts. Air taxiing at this height represents the upper level of the Hover In Ground Effect (HIGE) phenomenon where the maximum velocity of DW/OW winds may occur.

- 3.6.4.2 Air taxiing vertical flight aircraft may introduce hazardous effects in terms of DW/OW, which may vary significantly. The DW/OW hazards may be a risk to infrastructure, other aircraft, aerodrome personnel and the public.
- 3.6.4.3 Air taxi routes should not be located where the taxi-route would pass over, or adjacent to, facilities that could be adversely affected by the DW/OW. Areas that may be affected by DW/OW include but are not limited to:
 - aircraft parking positions
 - apron operations
 - passenger or public areas
 - the movement area.
- 3.6.4.4 When designing or nominating an air-taxi route it should have a minimum width of twice the overall width of the design vertical flight aircraft.
- 3.6.4.5 The aerodrome operator should assess any change to intended, or actual operation of helicopters or VCA on (or taxiing above) the manoeuvring area.
- 3.6.4.6 Table 12 shows the relationship between taxiway code strips and air-taxi route limitations. It also shows the maximum rotor widths for helicopter over Code B Taxiways, and both taxilanes will be less than the permitted wingspan.

Table 13: Taxiway code strips vs air-taxi route limitations

Taxiway	Code A taxiway	Code B taxiway	Code A taxilane	Code B taxilane
Strip Width (m)	31	40	24	33
Max. permitted wingspan (m)	<15	<24	<15	<24
Maximum overall width for an air-taxiing helicopter or VCA (m)	<15	20	12	16.5

Note: Table 12 only shows the minimum facility dimensions as per Part 139 MOS vs the guidance for taxi route clearance in AC 139.R-01. These figures only provide protection for the helicopter and do NOT consider the hazardous effects of DW/OW or helicopter wake turbulence to people, facilities, other aircraft or aerodrome operations.

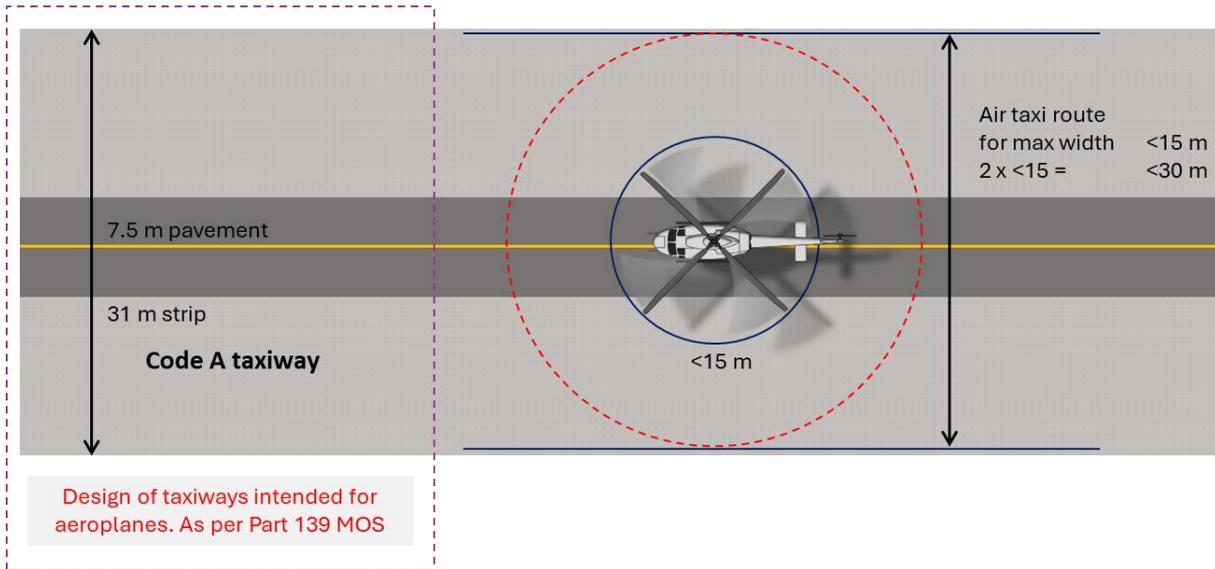


Figure 13: Code A taxiway dimensions vs air-taxi routes

(Source: CASA)

- 3.6.4.7 Figure 13 shows an illustration of a code A taxiway and taxiway strip vs the air taxi route width for a helicopter with a max width of <15 m.
- 3.6.4.8 Table 14 shows the relationship between taxiway code strips and air-taxi route limitations where there are parallel taxiways and taxilanes. The table shows that the maximum overall widths for vertical flight aircraft over all parallel taxiway and taxilanes will be less than the permitted wingspan.

Table 14: Parallel taxiway separation vs air-taxi route limitations

Parallel Taxiways	Code A taxiways	Code B taxiways	Code A taxilanes	Code B taxilanes
Centre line separation	23	32	19.5	28.5
Max. permitted wingspan (m)	15	24	15	24
Maximum overall width for an air-taxiing helicopter or VCA (m)	11.5	16	9.75	14.25

Note: Although the above information demonstrates helicopters and VCA may air taxi on taxiways designed for aeroplanes, albeit with reduced maximum rotor spans, when operating independently and when an aeroplane is operating on parallel taxiways or taxilanes, the gear deviation and increment required in the taxiway separation is halved. To minimise the risk, rotor span, aeroplane wingspan limitations or dependent aircraft operations may need to be considered in the context of operational requirements.

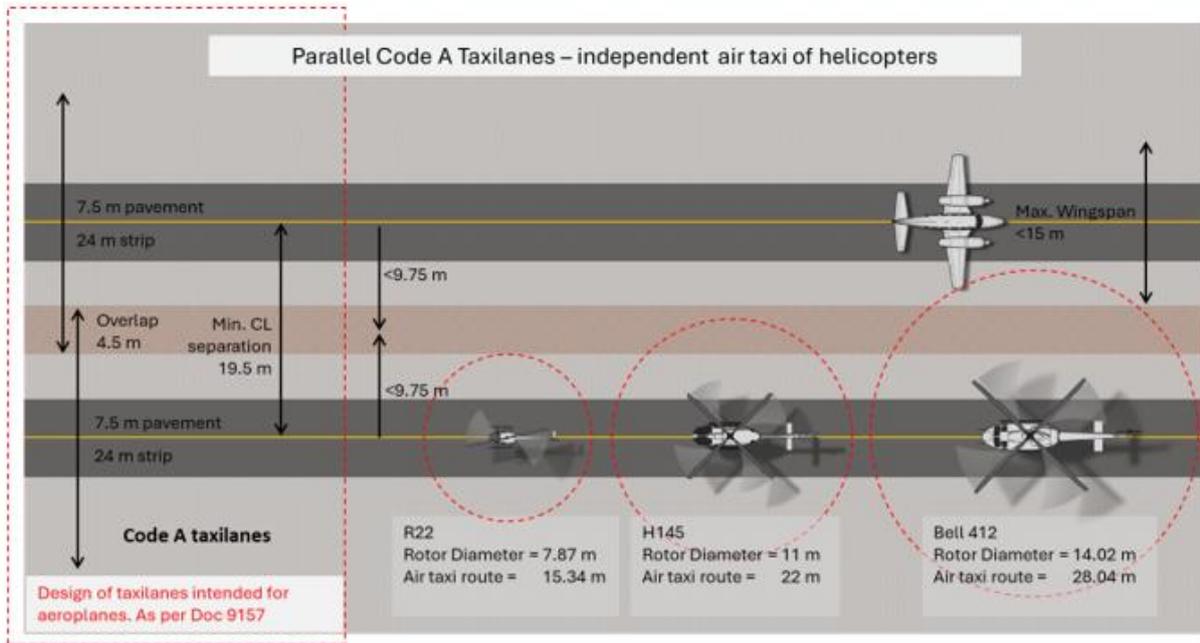


Figure 14: Parallel code A taxilanes and the air-taxi routes for 3 helicopters with a width of less than 15 m

(Source: CASA)

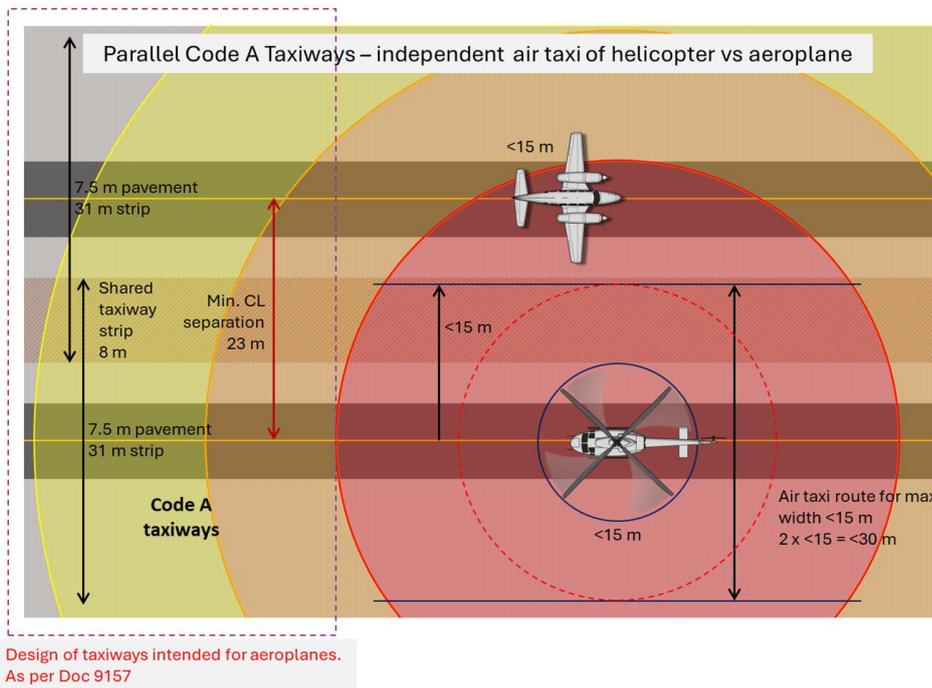


Figure 15: Parallel code A taxiways vs the potential peak wind velocities of a Bell 412

(Source: CASA)

Example:

The Bell 412, a popular aeromedical helicopter, has a rotor diameter under 15 m, making it technically suitable for air taxiing on a Code A taxiway. However, at distances beyond the edge of a Code A taxiway strip (15.5 m from the centreline), the helicopter can generate peak wind velocities exceeding 80 km/h. This could affect aircraft holding at an intersecting taxiway or operating on a parallel taxiway.

3.6.5 Air transit routes

- 3.6.5.1 Air transit routes are a nominated path on an aerodrome that allows for an aircraft to taxi at a height not above 100 ft and at a speed greater than 20 kts. Due to the higher speeds and altitude the DW/OW are more dissipated than they would be for the same aircraft air-taxiing but do create the potential for helicopter wake turbulence effects.
- 3.6.5.2 Where an aerodrome is limited to having vertical flight aircraft parking positions located away from FATO (or FATOs), and where an air-taxi route would introduce an unacceptable DW/OW hazards and risks, then air transit routes may be considered.
- 3.6.5.3 Downwash may extend to up to 10 rotor diameters below a helicopter when air transiting at speed less than 20 kts, and an equivalent distance for VCA aircraft. Downwash may be vertical below the helicopter or moved by wind. DW/OW should be considered by the aerodrome operator when determining preferred air transit routes above the aerodrome.

Note: The potential for helicopter wake turbulence exists when a helicopter air transits at speeds greater than 15-20 kts. See chapter 2.3 of this AC for the note on Caution: Wake turbulence.

- 3.6.5.4 Air transit routes should have the following attributes:
- airspace free of obstacles
 - not be above aircraft parking areas or where aircraft may be manoeuvring
 - not be above areas where people may be impacted by DW/OW
 - a corresponding area of ground below for suitable emergency (autorotative or one engine inoperative) landings
 - a width that would permit unhindered transit whilst allowing suitable space for errors in manoeuvring.
 - minimal variation in direction
 - air transit route/s should be described in aerodrome published information.



Figure 16: Bell Jet Ranger airborne over aerodrome taxiway markings

(Source: CASA)

3.7 Aprons for vertical flight aircraft

3.7.1 Apron design

- 3.7.1.1 The hazardous effects of DW/OW from a vertical flight aircraft, and integrated operations between vertical flight aircraft and aeroplanes on the same apron should be carefully assessed.
- 3.7.1.2 Aprons to be used exclusively by helicopters are divided into 2 design types based on their intended operations: those designed for accommodating air-taxi (or powered turn-out) parking, and those designed for ground taxi parking. These 2 stand types are D-value-based stands.
- 3.7.1.3 As well as the D-value-based stands, VCA aprons may also include geometry-based stands designed for (ground) taxi or tow-in and push back of VCA aircraft.
- 3.7.1.4 All D-value-based stands should have the following features:
- touchdown/positioning marking (as parking position marking)
 - a stand perimeter
 - a protection area.
- 3.7.1.5 Geometry-based stands should have the following features:
- touch down parking position marking (as parking position marking)
 - a protection area.

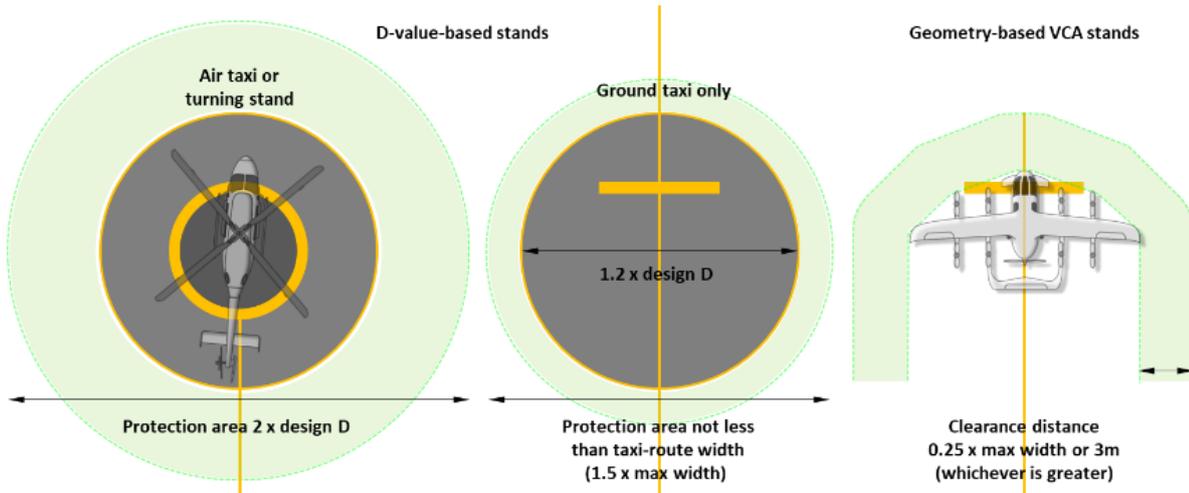


Figure 17: The basic stand geometry for the 3 types of stands (left to right) air-taxi or turning stand, a ground taxi (non-turning) stand and a VCA geometry-based stand

(Source: CASA)

3.7.2 D-Value-based aprons

General

- 3.7.2.1 D-value based stands use the design D for the aircraft(s) intended for that apron or stand (this may be a smaller design vertical flight aircraft than the design vertical flight aircraft for the overall aerodrome).
- 3.7.2.2 D-value stands should have a stand diameter of $1.2 \times \text{design D}$, surrounded by a stand protection area defined by the operational use of the stand.
- 3.7.2.3 The stand should have a touchdown positioning marking (TDPM) to correctly align for touchdown or parking.

Protection areas

- 3.7.2.4 A D-value based stand should be surrounded by a stand protection area which provides obstacle clearance protection for aircraft arriving and departing the stand.
- 3.7.2.5 For helicopters conducting air transport operations the recommended overall dimension of the stand protection area is $2 \times \text{design D}$ whether the vertical flight aircraft is air or ground taxiing.¹⁶
- 3.7.2.6 Stand protection areas may be overlapped where arrival and departures to stands are not simultaneous. The stand protection area should not overlap the actual stand perimeter of the adjacent stand.
- 3.7.2.7 For simultaneous arrival and departure operations, the protection areas should not overlap.

Touchdown/positioning markings (TDPM)

Touchdown/positioning marking - circle (TDPC)

- 3.7.2.8 A TDPC should be used wherever a helicopter or VCA is permitted to align their heading as required before touching down and may be used within:

¹⁶ This recommendation aligns with guidance from other NAAs for transport category heliports. Refer FAA AC 150/5390 as published from time to time.

- a. a FATO with a TLOF
- b. a TLOF located at the end of an air-taxi or air-transit route
- or
- c. a vertical flight aircraft stand.

3.7.2.9 A TDPC should be used any time a powered turn, either on the ground or in the air, is needed to position onto or exit the stand.

Touchdown/positioning marking - shoulder line (TDPS)

- 3.7.2.10 The TDPS is similar in use to a pilot stop line marking used on a fixed wing parking position.
- 3.7.2.11 A single direction TDPS should be used whenever a vertical flight aircraft needs to be aligned in one direction only.
- 3.7.2.12 When a single direction TDPS is used on a stand the aircraft can be pushed back from the stand or can taxi through following a continued alignment line.
- 3.7.2.13 For stands accommodating arrivals and departures from opposite directions 2 TDPS should be used.

Table 15: Types of apron operations vs the stand protection area and marking recommendations

Type of operations permitted			Stand protection area(min. total width)	Overlapped protection area	TDPM type
Ground taxi only	Simultaneous arrivals and departures	Taxi through ¹⁷	1.5 x design D	No	TDPS (dual or single1)
		Push back			Single TDPS
		Powered turn ¹⁸	2 x design D		TDPC
	Dependent arrivals and departures	Taxi through	1.5 x design D	Yes	TDPS (dual or single1)
		Push back			Single TDPS
		Powered turn	2 x design D		TDPC
Air taxi	Simultaneous arrivals and departures	Taxi through	2 x design D	No	TDPS (dual or single1)
		Powered turn			TDPC
	Dependent arrivals and departures	Taxi through		Yes	TDPS (dual or single1)
		Powered turn			TDPC

¹⁷ Taxi through parking positions (be they ground or air taxi) may be single or dual direction depending on the permitted apron operations and should be marked accordingly.

¹⁸ Powered turn means any ground or air turn under the aircrafts own power, including for alignment to park/touch down or to depart the bay.

Note: As per 3.7.2.5 it is recommended that air transport operations have a protection area of 2 x design D.

3.7.3 Apron design types

Mixed use aprons and parking stands

- 3.7.3.1 Although apron markings are not required for aircraft 5700 kg or less, where mixed use aprons and parking stands are intended, the unique attributes of vertical flight aircraft should be considered and markings provided where deemed appropriate.
- 3.7.3.2 Where an apron is intended for simultaneous mixed operations, and where the same parking position can be used by all form of aircraft the aerodrome operator should determine the most demanding design feature of each aircraft.
- 3.7.3.3 The most demanding feature may not always be the physical characteristics of the aircraft but may include hazards produced by the aircraft such as jet blast, prop wash or DW/OW. Turning radius, lead in lead out hazards from or to adjacent parking positions and aircraft servicing requirements may also be influencing factors.
- 3.7.3.4 Figure 18 show a fictional mixed-use apron. Contributing stand spacing factors include the turn radius for the fixed-wing aeroplane and ensuring the adjacent stand is affected by potential peak winds less than 60 km/h. The primary parking position markings (for the fixed-wing aircraft in this case) take precedent over the vertical flight aircraft markings. 2 x design D protection area shown for illustration purposes.

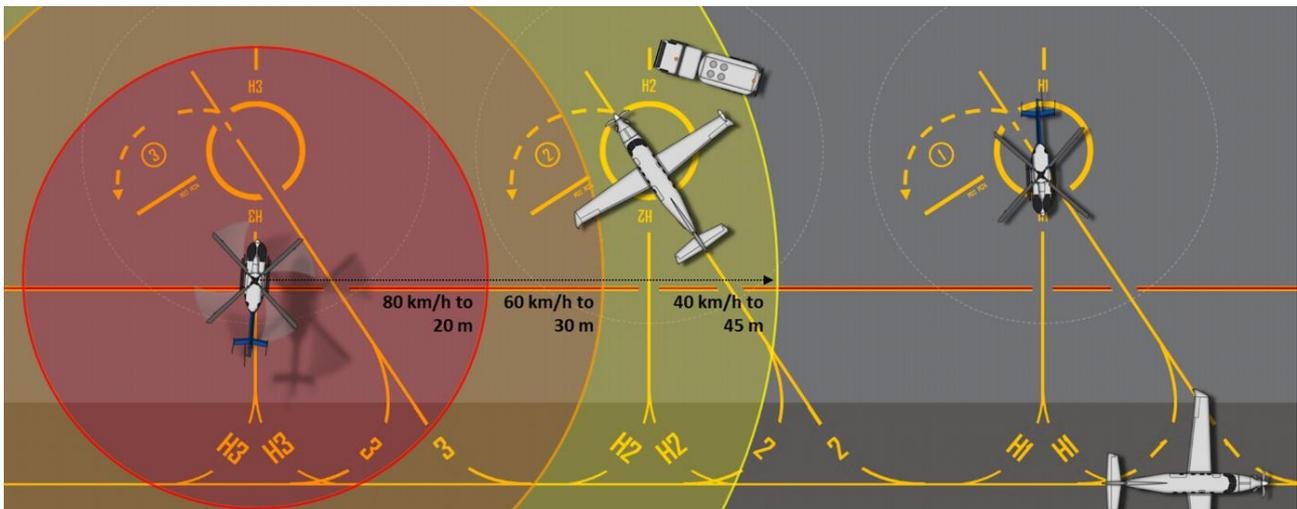


Figure 18: Mixed use apron design

(Source: CASA)

Ground taxi aprons

- 3.7.3.5 Notwithstanding subsection 3.7.2.5 of this AC, where an apron caters for ground taxiing operations that do not require a vertical flight aircraft to turn for alignment or to depart, then the protection area surrounding the stand may be 1.5 x design D in diameter. This is likely to be associated with a TDPS.
- 3.7.3.6 Where the vertical flight aircraft needs to turn to taxi out of the stand or to align with the wind while taxiing into the stand, then a larger protection area is required. A ground taxi stand,

accommodating a turn should have a protection area of 2 x design D. This is likely to be associated with a TDPC.

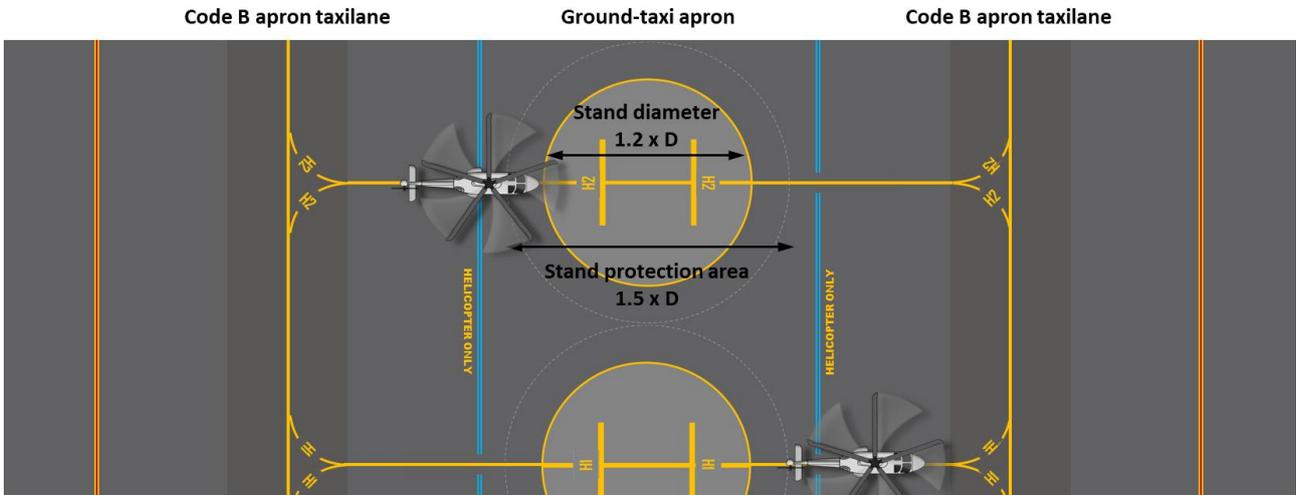


Figure 19: Simultaneous ground taxi apron

(Source: CASA)

3.7.3.7 Figure 19 shows an example of a helicopter apron that is designed for ground taxiing to the stands. These 2 stands are spaced for simultaneous operations with the stand protection areas not overlapping. The stands are marked with dual direction TDPS. The stand protection areas are shown for illustration purposes.

Air taxi aprons

3.7.3.8 Where an apron caters specifically for air taxiing operations then the required protection area surrounding the stand should be 2 x design D in diameter.

3.7.3.9 As with ground taxiing stands, the protection areas may only overlap if operations are non-simultaneous to adjacent stands.

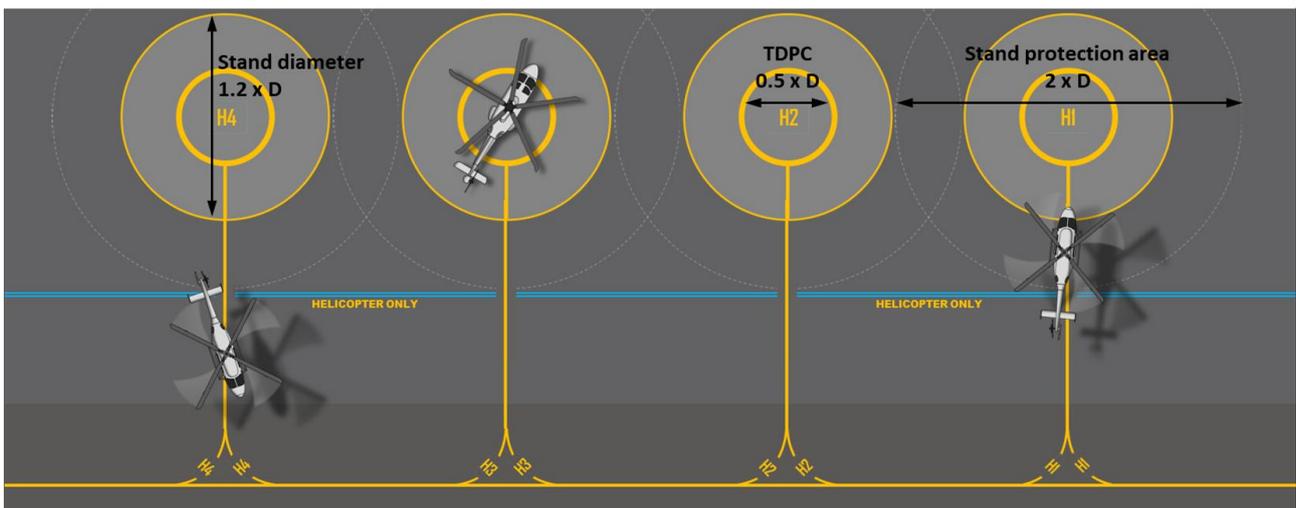


Figure 20: Non-simultaneous air-taxi apron

(Source: CASA)

3.7.3.10 Figure 20 shows an example of air-taxi stand spacing where the protection areas are overlapped for non-simultaneous operations.

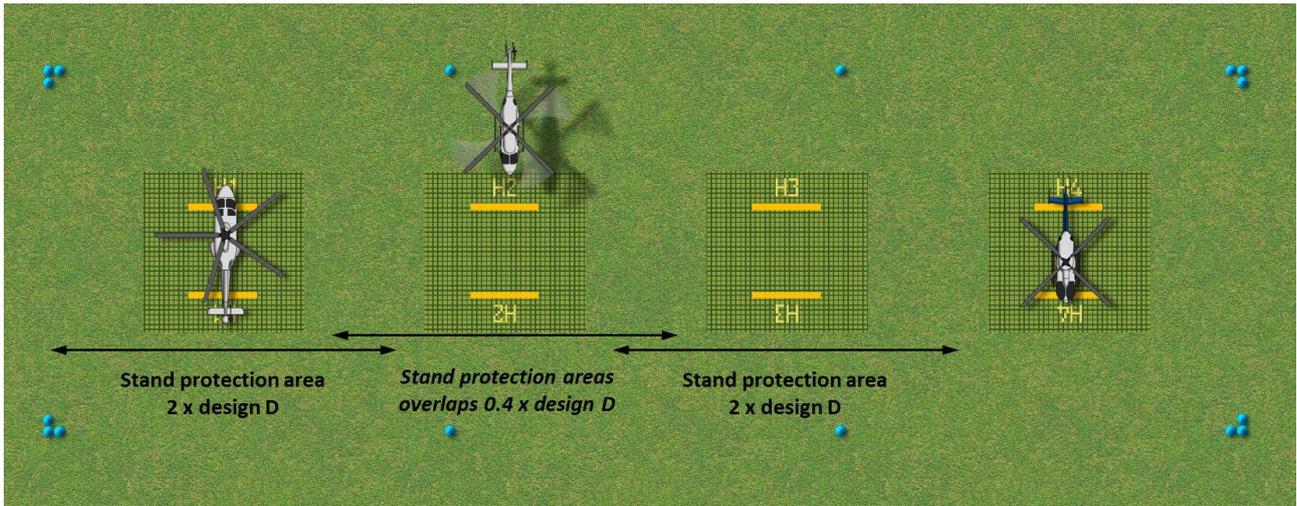


Figure 21: Non-simultaneous air-taxi (natural surface) apron

(Source: CASA)

3.7.3.11 Figure 21 shows an example of an air taxi apron with a natural surface with dual direction TDPS and stand numbering and intended for non-simultaneous arrival and departures. The illustration suggests grass stands with a ground reinforcing product.

TLOF on apron

3.7.3.12 Where a vertical flight aircraft is intended to touch down or lift off on an apron the TLOF should be surrounded by a stand protection area with a diameter of 2 x Design D.

3.7.3.13 The TLOF should be distinguishable from the parking areas of the apron using a parking clearance line.

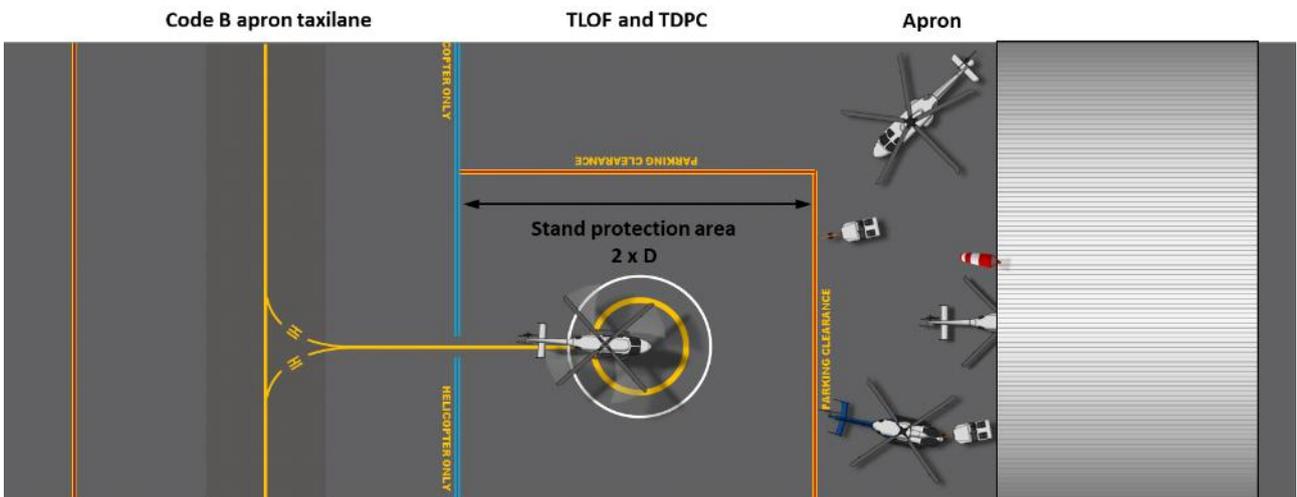


Figure 22: TLOF on an apron

(Source: CASA)

3.7.3.14 Figure 22 shows an example of how a TLOF might be designed. With TLOF and TDPC markings and the stand protection area surrounded by parking clearance lines (the stand protection area need not be square).

Narrow apron options

- 3.7.3.15 Narrow apron refers to situations where a stand or TLOF and its associated protection area cannot be accommodated within the boundary of the parking area. The following provides alternatives to facilitate air taxiing vertical flight aircraft.
- 3.7.3.16 Despite the recommendations in this section, an aerodrome operator (and aircraft operator, apron lease holder etc.) should conduct a safety assessment as part of the design process for any vertical flight facility (in this case aprons and apron taxilanes being used by vertical flight aircraft operators). The recommendations are based on taxi-route guidance and vertical flight aircraft stand dimensions and do not fully consider the hazard and associated risks of DW/OW in a confined apron scenario, as these hazards will change depending on the aircraft types in use and their operation, and the risk to other aircraft operations, people and equipment.
- 3.7.3.17 Where possible vertical flight aprons should be associated with an adjacent taxilane of not less than code B width. A Code B taxilane will provide an air-taxi route for vertical flight aircraft with a maximum overall width of up to 16.5 m¹⁹.

Note: Vertical flight aircraft with a maximum width of greater than 16.5 m will require more demanding taxilanes.

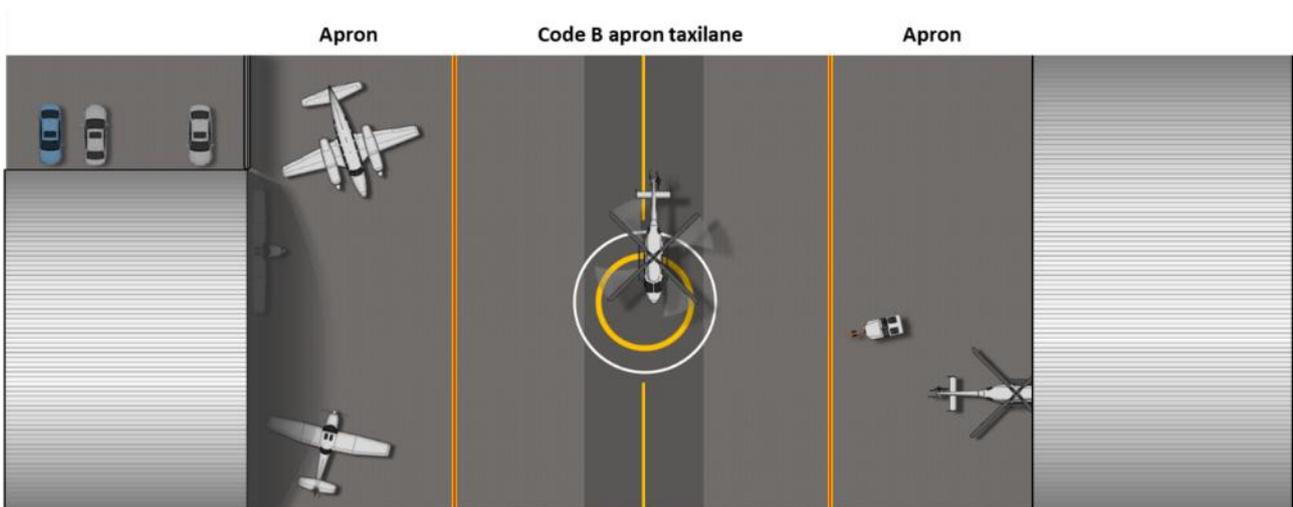


Figure 23: TLOF on a Code B taxilane

(Source: CASA)

- 3.7.3.18 Figure 23 shows an example of a TLOF and TDPC located on a Code B taxilane, where the destination parking area is too narrow to allow for an aircraft to safely touch down.
- 3.7.3.19 Where vertical flight aircraft are air-taxiing or air-transiting to a narrow parking position and a Code B taxilane or larger is adjacent, the TLOF with a TDPM should be provided centred on the taxilane.
- 3.7.3.20 Where a Code A taxilane is provided, then air transit or air-taxi operations should be restricted to vertical flight aircraft with a maximum overall width less than 12 m.²⁰
- 3.7.3.21 Where vertical flight aircraft are air-taxiing or air-transiting to the vicinity of a narrow parking position and a Code A taxilane is adjacent, a TLOF with a TDPM should be provided:

¹⁹ Refer to Table 13 for further information on air taxi route limitations.

²⁰ Refer to Table 13 for further information on air taxi route limitations.

- a. Centred such that the stand protection area is clear of any apron not associated with the vertical flight aircraft operation.
- b. Where the stand protection area extends beyond the edge of the taxilane, an equipment clearance line should be marked to ensure the TLOF is free of obstacles during lift-off and touch down operations.

Notes:

- 1. Refer to chapter 8 of the Part 139 MOS for equipment clearance line specifications.
- 2. Other aerodrome users should be considered by the aerodrome operator when intending to locate a TLOF on a taxiway or taxilane. Vertical flight aircraft operators will need to consider delays to other aerodrome users when their aircraft is using the TLOF.

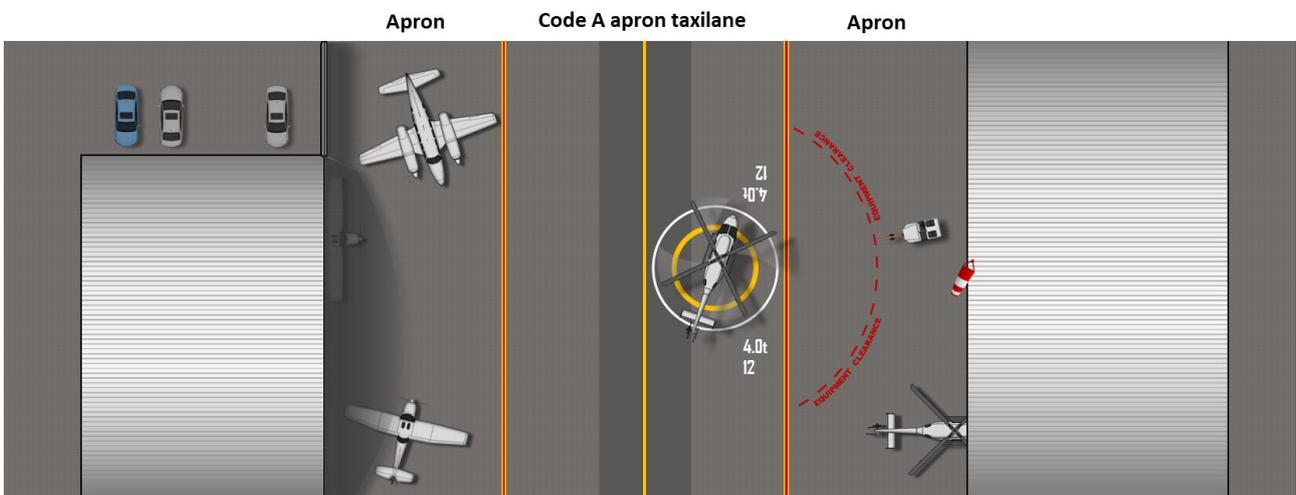


Figure 24: TLOF for a narrow parking area

(Source: CASA)

3.7.3.22 Figure 24 shows a narrow parking area example on a code A apron taxilane. The protection area outlined with the use of an equipment clearance line.

3.7.4 Geometry-based aprons

3.7.4.1 Geometry based stands were introduced in AC 139-V.01 to accommodate VCA operations where the aircraft will ground taxi or be towed to a stand. Figure 25 shows an example of a geometry based apron.

3.7.4.2 Geometry based stands may be used for aprons designed for VCAs that will be ground taxied into the parking position, then pushed back for departure.

Note: Further details of the geometry-based stands are included in AC 139.V-01.

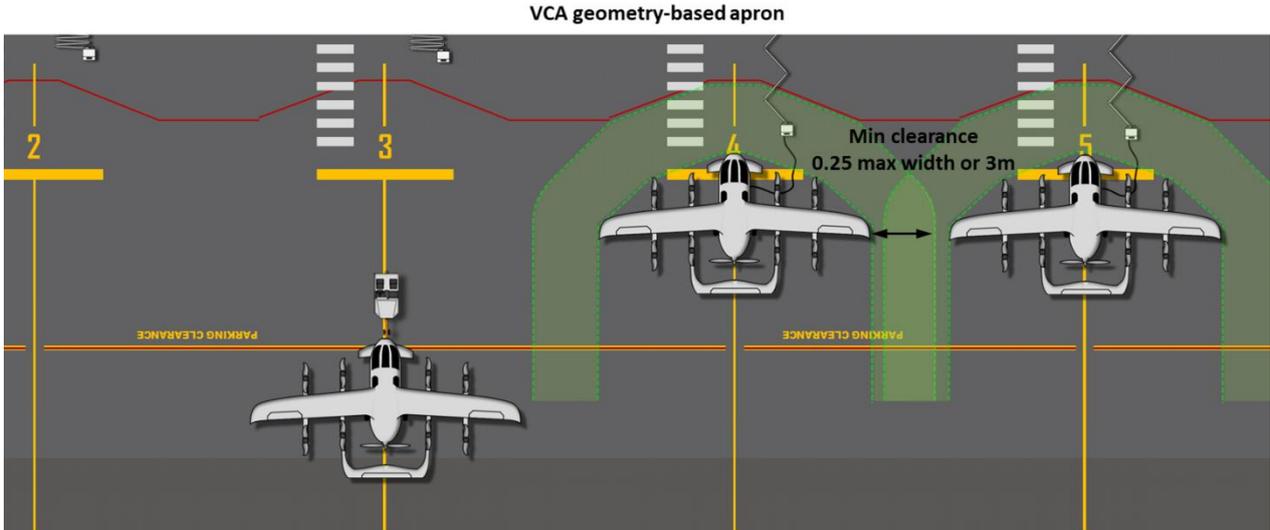


Figure 25: Geometry-based apron

(Source: CASA)

4 Obstacle limitation surfaces

Existing aerodromes will already have obstacle limitation surfaces (OLS) established. However, protection surfaces for on aerodrome helicopter facilities have been very rarely included as part of an aerodromes OLS.

4.1 Aeronautical assessments

- 4.1.1 An assessment of intended activities at an airport, the introduction of new aviation infrastructure in the vicinity of an aerodrome, or the introduction of more demanding aircraft may trigger the need for an aeronautical study to determine whether hazards and risks to the aerodrome, or those aircraft intending to use the aerodrome, remain acceptable to the aerodrome operator and those using the facility.

Note: Chapter 4 of AC 139.R-01 provides details on the process of an aeronautical assessment for heliports. This process can be equally applied to vertical flight facilities at an aerodrome.

4.2 OLS general specifications

- 4.2.1 Where the aerodrome has nominated the runway as the FATO for vertical flight aircraft operations then no additional OLS is required for vertical flight aircraft operations.
- 4.2.2 All other FATOs should have at least the following protection surfaces prepared:
- the FATO protection area
 - take-off climb and approach surface/s.
- 4.2.3 Transitional surfaces or side slopes are included (when required).
- 4.2.4 Aerodrome operator should ensure that no permanent or transient objects penetrate the surfaces during flight operations to and from the FATO.

4.2.5 FATO protection area

- 4.2.5.1 A FATO should be surrounded by an area that is free from obstacles. The FATO protection area (or safety area) is intended to reduce the risk to an aircraft should it diverge from the centre of the FATO.

Note: For a FATO planned for helicopter operations, the safety area should be designed as per the specifications outlined in section 3.1 of AC 139.R-01.

Where no helicopter operations are planned, the protection area should be designed as per the specifications in section 4.2 of AC 139.V-01.

4.2.6 Take-off climb and approach surface

- 4.2.6.1 Aerodrome operators may design their take-off climb and approach surface as per the guidance in chapter 4 of AC 139.R-01, or they may use the take-off/approach slope design guidance in chapter 4 of AC 139.V-01.
- 4.2.6.2 A slope of 8% is recommended for the take-off climb and approach surfaces for a FATO at an aerodrome. This slope will allow for helicopters operating performance classes (PC) 2 and 3.

- 4.2.6.3 Where an aerodrome intends to accommodate helicopters operating performance class 1 (PC 1):
 - a. The aerodrome operator may publish information that PC1 operations be restricted to arriving and departing from a runway.
 - b. where (a) is not preferred and the aircraft operator needs to perform PC1 operations, the take-off climb and approach surfaces should be designed with a 4.5% slope
- 4.2.6.4 Where an aerodrome plans to accommodate VCA but not helicopters then the slope for the take-off climb surface slope or combination of slopes and section lengths should be determined with reference to the obstacle environment and intended aircraft performance capabilities.

Note: Refer to chapter 4 of AC 139.R-01 or AC 139.V-01 for specifications on take-off climb and approach surfaces.

Performance Class 1 (PC1) operations

For many existing aerodromes, a take-off climb and approach surface with slope of 4.5% for a standalone FATO, may impose unintended operational restrictions on the airfield (such as needing to hold aircraft some distance from the FATO to ensure the FATO OLS is not infringed).

Aerodrome operators have the option that where the approach or take-off climb surfaces, to a standalone FATO, cannot be provided for PC1 operations, then approach and take-off climb, for PC1 operations, should be limited to a runway.

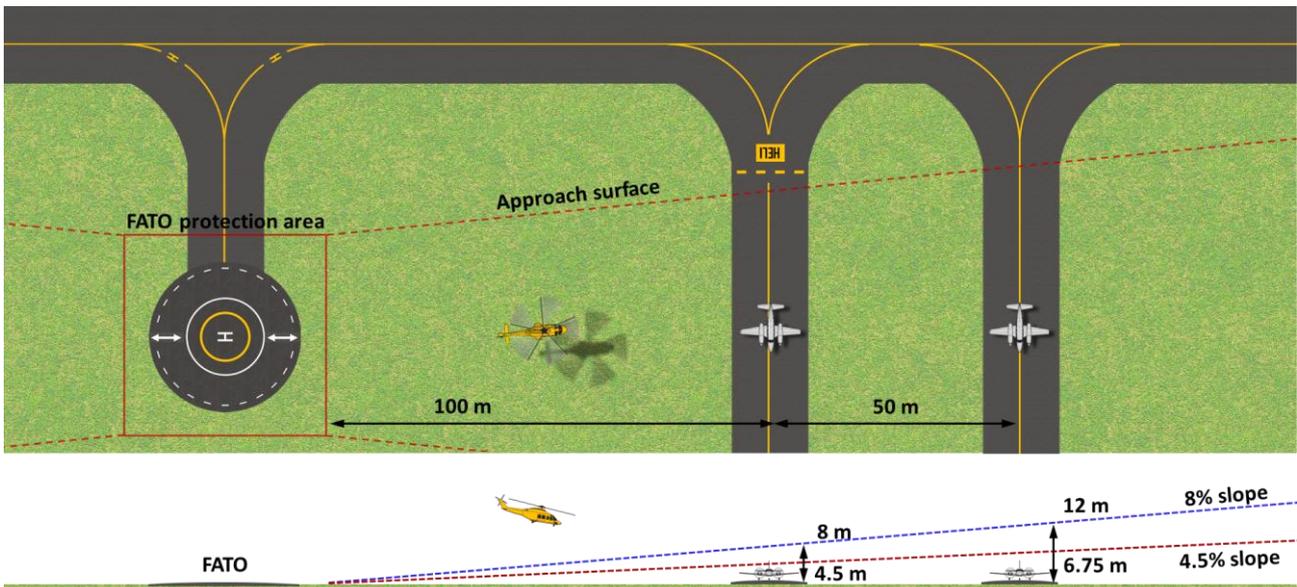


Figure 26: FATO approach and departure slope options

(Source: CASA)

- 4.2.6.5 Figure 26 shows a visualisation of the 4.5% vs the 8% approach/departure slopes and possible infringements of the slope with taxiways located at particular distances from the FATO.

4.2.7 Transitional surface

- 4.2.7.1 In AC 139.R the transitional surface is only specified for heliports that support a point-in-space (PinS) approach procedure utilizing a visual segment surface. However, an aerodrome operator

may choose to include the transitional surfaces where a safety assessment determines that additional lateral protection may be required.

Note: Aerodrome operators may design their FATO transitional surfaces as per the guidance in Chapter 4 of AC 139.R-01 chapter 4, or they may use the simplified transitional surface design guidance in Chapter 4 of AC 139.V-01.

4.2.8 Stand protection area

4.2.8.1 The stand protection area should also be thought of as part of the obstacle protection surfaces. Details of the stand protection area specifications are covered in chapter 3.7 of this AC.

5 Visual aids

5.1 General

5.1.1 All specifications for the markings described in this chapter can be found in:

Note: Chapter 5 Visual Aids of either AC 139.R-01 or AC 139.V-01.

5.1.2 Markers and markings should be clearly visible to the facility user by way of:

- a. provision of a contrasting background marking (a box or border)
- b. where allowed for in the specifications below, the selection of an appropriate contrasting colour
- c. any other method that would increase the conspicuity of the marking or marker in operational conditions.

5.1.3 The night-time visibility of markers and markings may be supplemented by reflective/refractive material providing that such material does not pose a hazard if dislodged.

5.2 Options for marking the FATO

5.2.1 Where an aerodrome has a FATO or FATOs for their vertical flight aircraft operations then the FATO/s should be marked.

5.2.2 However, where a FATO is clearly self-evident against its respective background, such as a paved FATO on a grassed area, then the FATO perimeter marking is not required. In all other cases a perimeter marking should be provided.

5.2.3 Markings that may be used within a FATO, depending on its intended operations, include:

- FATO perimeter marking
- TLOF perimeter marking
- touchdown positioning markings (shoulder line or circle)
- aiming point marking
- heliport identification marking
- flight path alignment guidance line.

5.2.4 The marked shape of the FATO is optional, so, long as it meets the required size specifications.

Note: Based on research²¹ conducted by the FAA, a square FATO is the preferred visual cue for judging the rate of closure, altitude, attitude and angle of approach.

²¹ See the National EMS Pilots Association (NEMSPA) survey, 2011.

5.2.5 Standalone FATO with an aiming point

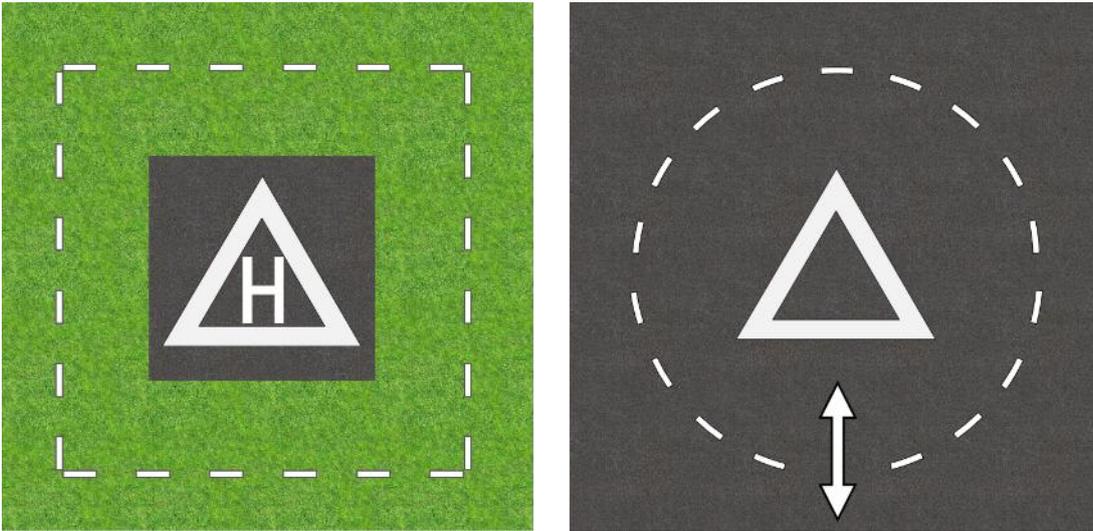


Figure 27: Aiming point FATOs

5.2.5.1 Figure 27 provides 2 examples of FATOs marked with FATO perimeter and aiming point markings. Optional heliport identification marking (left) and a flight path alignment guidance marking (right) are shown.

5.2.5.2 Where a FATO is provided for a vertical flight aircraft to arrive and depart but NOT touch down then the FATO should be marked with:

- a dashed white FATO perimeter marking (or markers)
- a white aiming point marking (triangle)

optionally:

- a heliport identification marking
- flight path alignment guidance markings
- D-value markings.

5.2.6 Standalone FATO with a TLOF

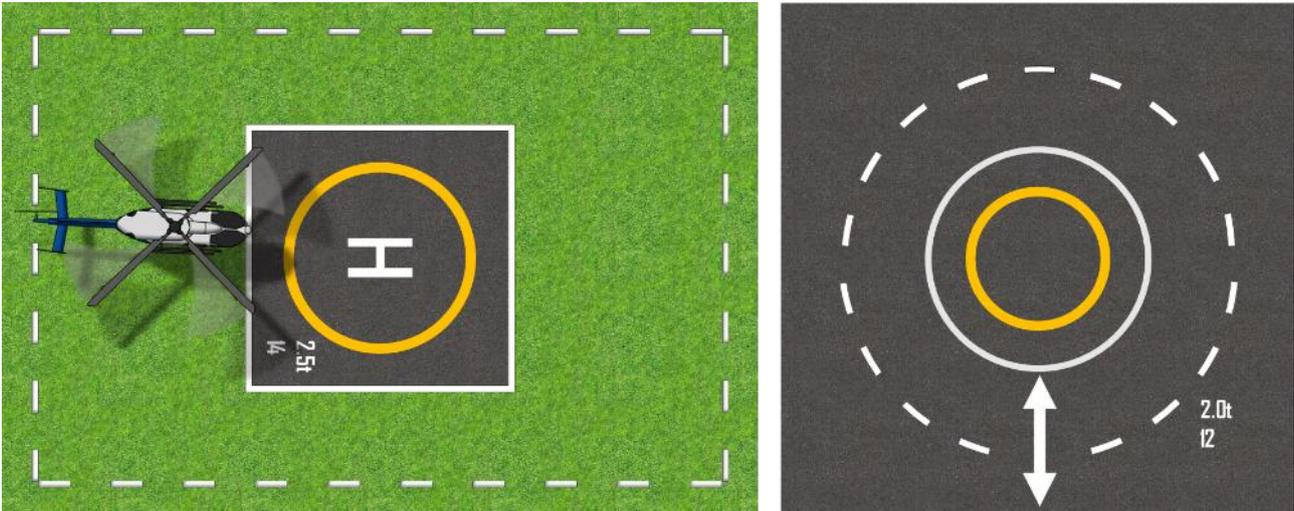


Figure 28: FATOs with a TLOF

(Source: CASA)

5.2.6.1 Figure 28 provides 2 examples of FATOs marked with FATO perimeter markers and markings respectively, TLOF perimeter and TDPC markings. Optional markings shown are a heliport identification marking (left) and a flight path alignment guidance marking, plus a maximum mass and a D-value marking (right).

5.2.6.2 Where a FATO is provided for a helicopter/VCA to arrive and to touchdown then alignment guidance should be provided. This FATO should be marked with:

- a dashed white FATO perimeter marking
- a solid white TLOF perimeter marking
- a yellow touchdown/positioning marking; shoulder-line or circle (TDPS or TDPC).

Optional additional:

- a heliport identification marking
- maximum allowable mass and/or D-value markings
- flight path alignment guidance markings.

5.2.7 Runway type FATO

5.2.7.1 An aerodrome operator may choose to provide a runway type FATO for helicopter/VCA operations. A runway type FATO should be marked by:

- 1 m x 9 m white FATO edge markings on pavement
- 1 m x 3 m gables on a natural surface (preferably banded in white and red or white and orange)
- 9 m runway designation markings that include the letter H above the two-digit runway heading numbers

optionally:

- a yellow touchdown positioning alignment marking²².

5.2.8 Taxiway or taxiway intersection nominated as a FATO

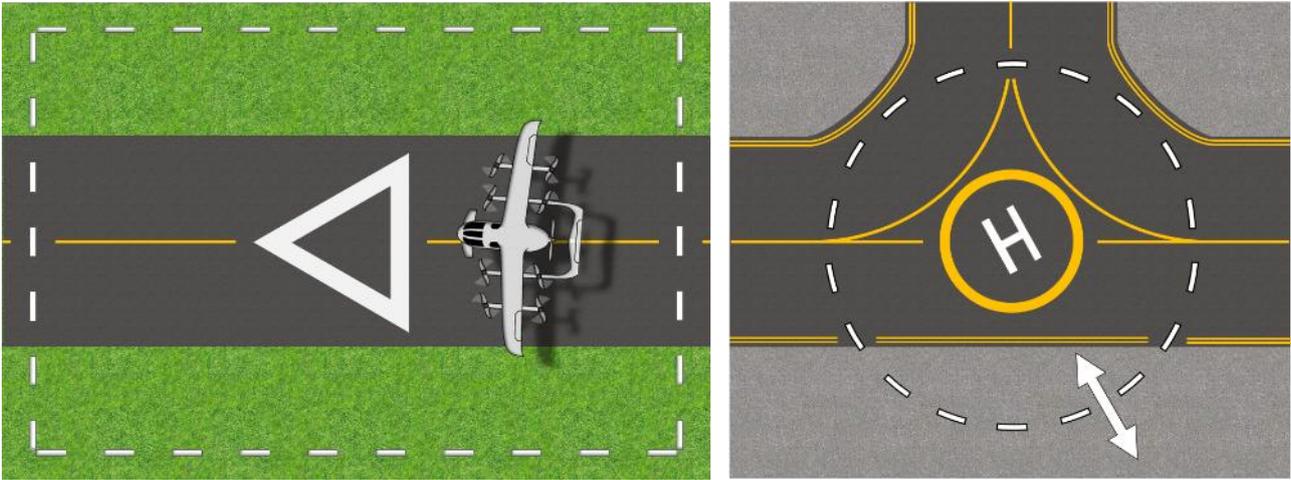


Figure 29: Taxiways with a FATO

(Source: CASA)

- 5.2.8.1 Figure 29 provides 2 examples of taxiway areas nominated as FATOs marked with FATO perimeter markings and markers and an aiming point (left) and a TDPC and flight path alignment guidance marking (right).
- 5.2.8.2 An aerodrome operator may nominate a section of taxiway or a taxiway intersection as a FATO for vertical flight operations. The area designated as a FATO should be marked by:
- a dashed white FATO perimeter marking (or markers)
- optional additional:
- a white aiming point marking or yellow touchdown/positioning marking
 - flight path alignment guidance markings
 - maximum allowable mass and/or D-value markings
 - heliport identification marking.
- 5.2.8.3 If a taxiway is nominated for vertical flight aircraft to touchdown and the taxiway surface is self-evident or already marked with taxiway edge markings, a white TLOF perimeter marking is not required. However, a yellow TDPM should be marked anytime touchdown is intended.

²² Refer to Figure 9 of this AC for examples of runway type FATOs.

5.2.9 Additional marking considerations for aerodrome FATOs

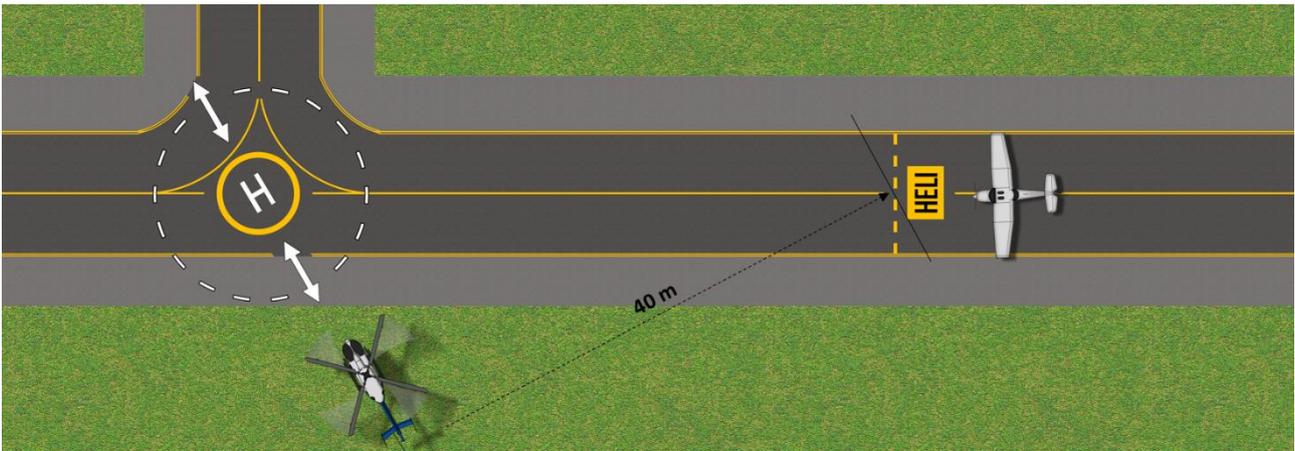


Figure 30: FATO on a taxiway clearance to holding position

(Source: CASA)

- 5.2.9.1 Figure 30 shows an example showing an aircraft stopped at a holding position and information marking while a helicopter completes an approach to an aerodrome's FATO.
- 5.2.9.2 A FATO should be protected from incursions during their use in a similar manner to runways when that runway is in use.
- 5.2.9.3 Where an approach or take-off climb surface, for a vertical flight aircraft crosses over a taxiway:
 - Intermediate holding position markings and information markings or movement area guidance signs (MAGS) should be considered to warn aerodrome users of the FATO area and ensure other aircraft can be held short from an operational FATO.
 - Intermediate holding positions should be marked not less than 40 m away from the extended approach and departure path to the FATO.
- 5.2.9.4 Specifications for holding point marking and information markings can be found in Chapter 8 of the Part 139 MOS.

Note: Recommended text for information marking or MAGS should be HELI.

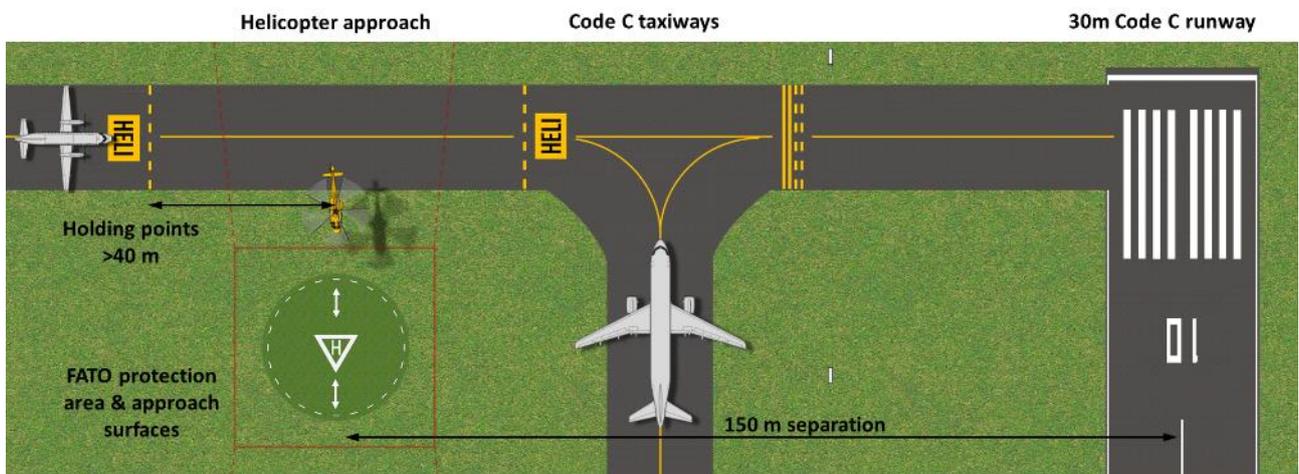


Figure 31: Standalone FATO and separation distances

(Source: CASA)

5.2.9.5 Figure 31 shows an example of a FATO, with an aiming point, adjacent to a runway, with both being used for parallel simultaneous operations. Holding points are located where the approach crosses the taxiway.

5.3 Touchdown/positioning markings

5.3.1 A touchdown/positioning marking, being either a touchdown/positioning shoulder-line (TDPS) or a touchdown/positioning circle (TDPC) are the markings that a pilot uses to align their vertical flight aircraft within the TLOF or a stand before touching down, or when parking.

Notes:

1. Specifications for TDPC and TDPS markings can be found in Chapters 5 of AC 139.R-01 and AC 139.V-01.
2. Pilot awareness of the purpose of visual aids is increasing. However, not all pilots may be aware of the operational intention denoted by a marking. Visual aids are provided to give pilots guidance, situational awareness and to mitigate hazards.
3. Controls intended by the markings may not be universally understood. Hence, published information should reflect the intent of the marking.
4. For instance, as shown in Figure 32, the correct alignment on a TDPC should have the pilots' seat over the yellow TDPC. (Left hand image below)
5. If a pilot approaches to align their seating position with the correct alignment within the TDPC it reduces the potential risk of a tail rotor strike during the final approach to the TLOF.
6. Whilst it may seem counterintuitive, even for an R22 arriving to a TLOF designed with a much larger design D (Figure 33) the pilot should still touch down aligned with the TDPM to reinforce the correct use of the marking.

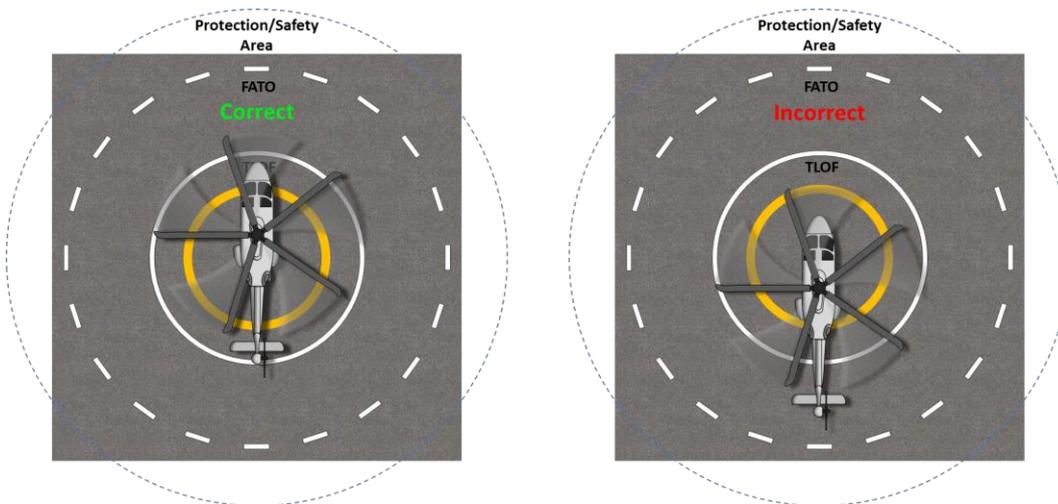


Figure 32: Correct touch down alignment over the TDPC vs incorrect alignment touch down on the "H" marking

(Source: CASA)

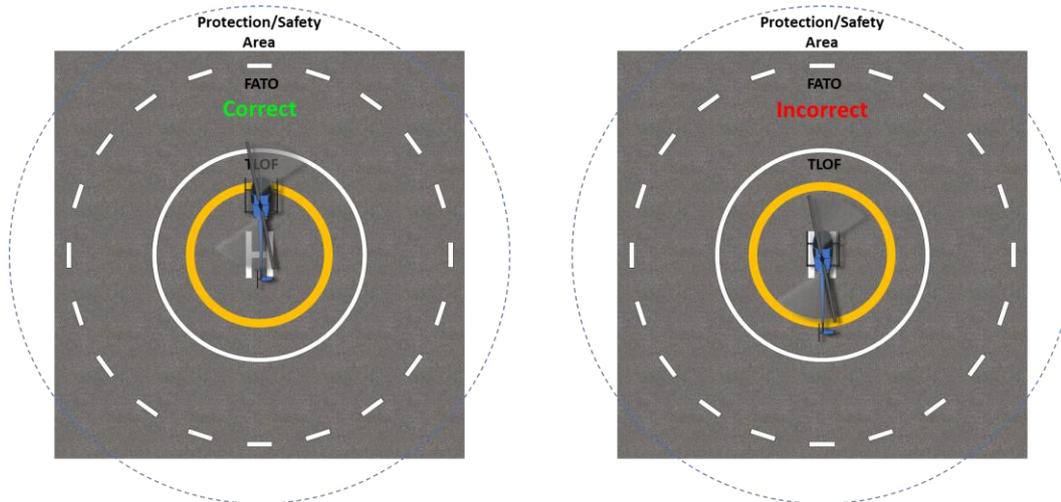


Figure 33: An R22 correctly aligned on a TDPC with a larger design D vs incorrect alignment on the "H" marking

(Source: CASA)

5.4 Marking the taxiways and taxi-routes

5.4.1 Ground taxi routes

- 5.4.1.1 A paved taxiway for ground taxiing should be marked in the same manner as described in Part 139 MOS Chapter 8.
- 5.4.1.2 A ground taxi taxiway restricted to the use of vertical flight aircraft only should be marked with a letter H.

5.4.2 Air taxi route

- 5.4.2.1 An air-taxi route, where there is no paved surface, should be marked with a yellow markers showing the centre of the air-taxi route. Where there is a paved surface below the air-taxi route the marking should be a continuous line.
- 5.4.2.2 Where a centreline marking is not provided, the edge of the air taxi route may be marked with blue cones. They should be located at the edge of the air taxi route, being 2 times the maximum width of the largest vertical flight aircraft intended to use the air taxi route. The markers should be spaced at intervals of not more than 30 m on straight sections and 15 m on curves.
- 5.4.2.3 Where an unpaved air taxi route originates on a paved surface the route may be marked with the letter 'H' and the text 'AIR TAXI'.
- 5.4.2.4 Information only movement area guidance signs (MAGS) with the text 'AIR TAXI' may also be provided.

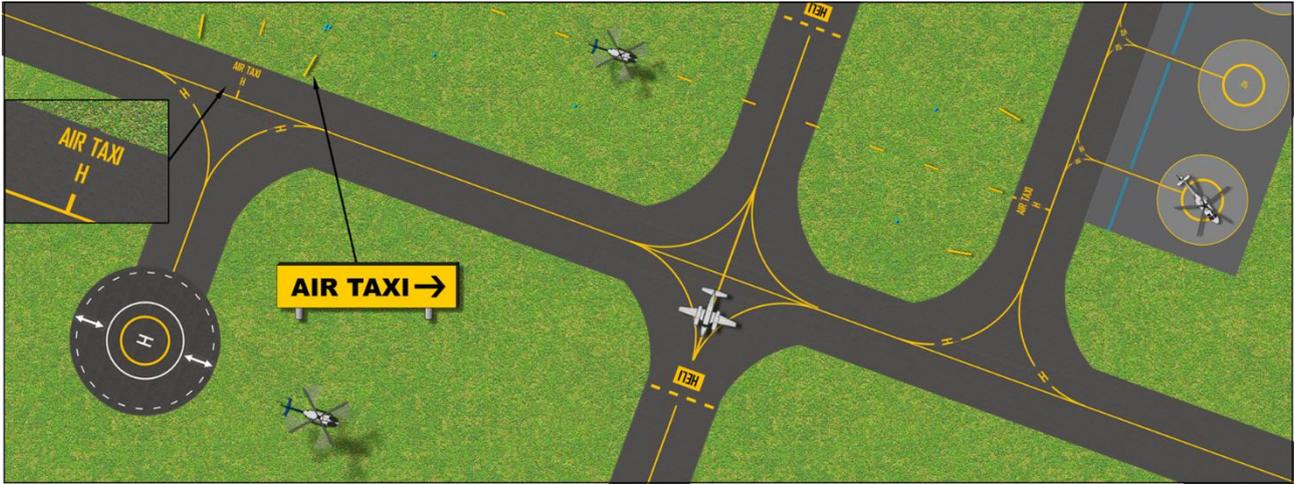


Figure 34: Air-taxi route markings

(Source: CASA)

5.4.2.5 Figure 34 shows an example of a fictitious aerodrome's movement area showing a FATO, vertical flight aircraft ground taxiway with centrelines prefixed with an H, and an unpaved air-taxi route marked by in ground markers, blue cones, MAGS and 'AIR TAXI' and 'H' ground markings.

Note: Further information on the markings for an air-taxi route can be found in Chapter 5 of AC 139.R-01.

5.5 Marking stands and aprons

5.5.1 General

5.5.1.1 Aprons design to accommodate vertical flight aircraft should be marked.

Note: Part 139 MOS requires that on a sealed, asphalt or concrete apron taxi guideline and parking positions must be marked for aircraft greater than 5,700 kg. Due to the nature of hazards like DW/OW and tail rotors, aerodrome operators should assess if vertical flight aircraft aprons for aircraft 5700 kg or less should be marked.

5.5.1.2 Vertical flight aircraft apron markings should consist of:

- apron and/or stand perimeter marking
- a touchdown/positioning marking (either a TDPC or TDPS)
- lead in/lead-out markings.

optionally:

- an alignment line
- a stand designation marking
- stand limitation markings
- apron safety lines.

Note: The specifications for stand markings listed above can be found in AC 139.R-01 and AC 139.V-01 Chapter 5, unless otherwise specified herein.

5.5.1.3 Generally, stand and apron guidance markings should be yellow in colour.

5.5.1.4 Contradictory or confusing overlapping markings should be avoided.

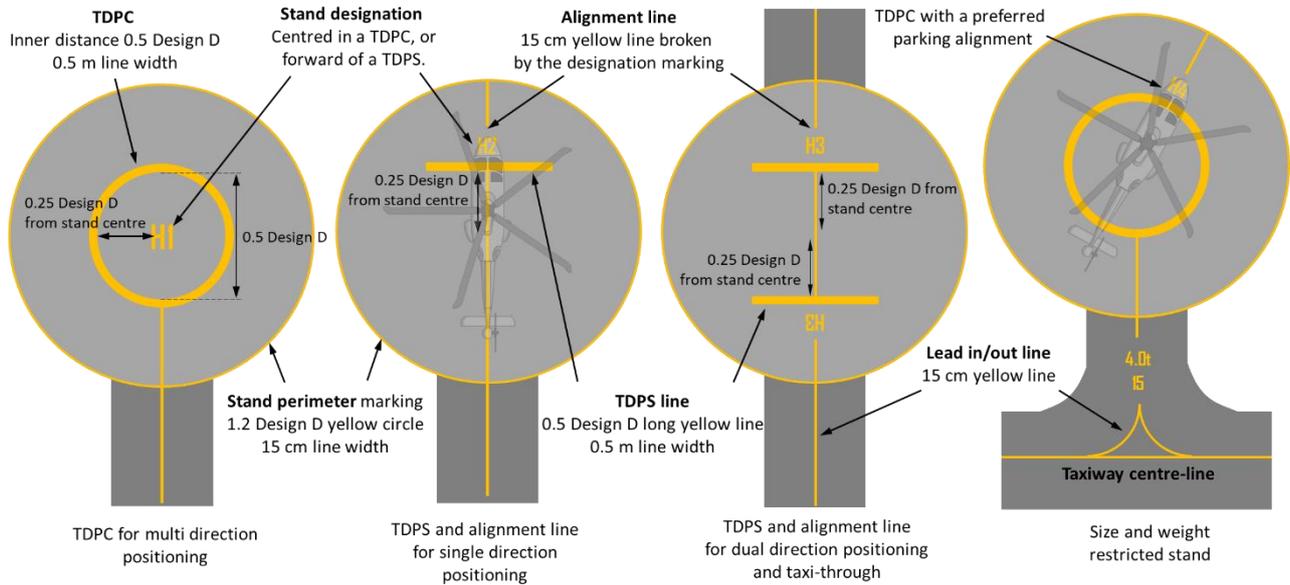


Figure 35: Stand layouts

(Source: CASA)

5.5.1.5 Figure 35 shows the general layout for D-value stand markings showing TDPC, TDPSs, stand perimeter, alignment lines and stand restriction markings. Image is for illustration purposes only; stands are not correctly spaced from each other.

5.5.2 Apron and stand perimeters

5.5.2.1 An aerodrome apron exclusively for vertical flight operations should be clearly distinguishable from a fixed-wing apron.

5.5.2.2 On a paved apron the parking clearance line (usually marked by yellow-red-yellow continuous line) should instead be marked by:

- a. double blue lines 0.15 m wide and 0.15 m apart
- b. the text "HELICOPTER ONLY":
 - i. marked in yellow letters 0.5 m high along the edge of the marking, and 0.15 m outside the vertical flight aircraft apron
 - ii. legible to pilots of approaching aircraft
 - iii. repeated at intervals not exceeding 50m along the vertical flight aircraft apron edge marking.

5.5.2.3 On an unpaved surface, a vertical flight aircraft exclusive apron should have its edges marked by blue cones evenly spaced 30-60m apart. Corners of the apron may be highlighted by using 3 cones set in a 90-degree pattern to each other.

- 5.5.2.4 A stand perimeter marking may be included²³, this will provide pilots and ground crew with an indication of the stand containment area.

5.5.3 Touchdown positioning markings

- 5.5.3.1 A touchdown/positioning marking (TDPM) should be provided to each vertical flight aircraft stand, whether a stand is used for ground taxi or air-taxi to and from the stand.
- 5.5.3.2 For ground taxiing aprons where the stand is designed for either a through taxi or a taxi-on and push off, then the recommended TDPM is a TDPS.
- 5.5.3.3 For stands that accommodate air-taxiing aircraft or that require an aircraft to turn on the stand (either on the ground or in the air) then the stand should be marked with a TDPC.
- 5.5.3.4 For geometry based VCA stands a TDPS should be used in the same manner that a stop line is used for a fixed wing aircraft.
- 5.5.3.5 On a geometry based stand the TDPS should be positioned based on the shoulder position of the pilot of the design vertical flight aircraft (in this case being the aircraft with the greatest distance from the pilots' shoulder position to the nose of the aircraft).
- 5.5.3.6 When marked in the correct location, all aircraft types for that stand should fit within the footprint of the design vertical flight aircraft (for this, the design vertical flight aircraft will be the amalgamation of the geometrical shapes of all the aircraft types for that stand.)

5.5.4 Stand designation numbers

- 5.5.4.1 Where multiple stands need to be identifiable, stand designation markings²⁴ should be used. For vertical flight aircraft exclusive stands these should be ordinal numbers preceded by the letter H or other suitable identifier.
- 5.5.4.2 For stands with a TDPC the designation should be centrally positioned within the TDPC, or if there is a preferred alignment then located on the outside of the TDPC along with an alignment line.
- 5.5.4.3 For stands with a TDPS the stand designation should be positioned on top of the shoulder line centred with the alignment line, so the pilot can read the marking as they enter the stand.
- 5.5.4.4 The marking should be marking in a font and size that is large enough to be read by the pilot when approaching the stand but not less than 0.5 m in its longest dimension.
- 5.5.4.5 The alignment line should be broken either side of the designation marking.

5.6 Vertical flight visual aids - Lighting

5.6.1 General

Note: Where the Part 139 MOS does not provide for the necessary visual aid for the intended operations of vertical flight aircraft, specifications for the lighting described in this chapter can be found in Chapter 5 Visual Aids of either AC 139.R-01 or AC 139.V-01.

- 5.6.1.1 Where vertical flight aircraft operations are conducted at night to facilities at an aerodrome then those facilities should be lit.

²³ Refer figure 32 of this AC for illustration of

²⁴ For examples for stand designation numbers refer to Figure 32 in this AC.

Note: This may include both vertical flight specific facilities and fixed wing aerodrome facilities being used at night for vertical flight aircraft operations.

- 5.6.1.2 The photometrics for vertical flight facility lights and lighting elements (including light output, vertical and horizontal distribution, and chromaticity), at an aerodrome, should be appropriate to the aerodrome environment and intended operations without being visually distracting or confusing to pilots.
- 5.6.1.3 If the operating environment varies and if needed, lighting systems should be adjustable to achieve the appropriate intensity.
- 5.6.1.4 In cases where operations into a vertical flight facility at an aerodrome are to be conducted at night with night vision imaging systems (NVIS), it is important to consider having lighted facilities compatible with the NVIS through the addition of technologies capable of emitting an IR signature. Where the addition of infrared emitters is not practicable, helicopter operators using NVIS should be warned to use extra caution.
- 5.6.1.5 Aerodrome operators that have vertical flight facilities with pilot activated lights (PAL) may choose to:
- include that facility lighting on the same PAL frequency
 - or
 - provide that specific facility lighting on a separate PAL frequency.

Notes:

- Having a separate PAL frequency may be useful where vertical flight aircraft operators are using NVIS but the aerodromes legacy (fixed-wing) facilities are not NVIS compatible but where the vertical flight specific facility lighting is.
- Vertical flight aircraft operators would then have the option of only selecting the NVIS compatible vertical flight facilities while leaving the rest of the aerodrome lighting off thus reducing glare and distraction for the pilot.

- 5.6.1.6 Vertical flight facilities at an aerodrome may have a combination of the following lighting systems:
- approach lighting system
 - flight path alignment guidance lights
 - FATO perimeter
 - aiming point lights
 - TLOF perimeter lights
 - TDPC lighting.

5.6.2 FATO lighting

- 5.6.2.1 A FATO (including when a runway is nominated as a FATO) at an aerodrome intended for night operations by vertical flight aircraft should:
- where a runway is nominated at the FATO, be lit by runway edge lighting as described in Chapter 9 of the Part 139 MOS
 - in all other cases be lit by combinations of:
 - FATO perimeter lights

- ii. TLOF perimeter lights
- iii. aiming point lights
- iv. TDPC lighting segments.

5.6.2.2 Where it is desirable and practicable to indicate a preferred approach direction to FATO then the FATO lighting above may be supplemented by:

- a. an approach lighting system
- or
- b. flight path alignment guidance lights.

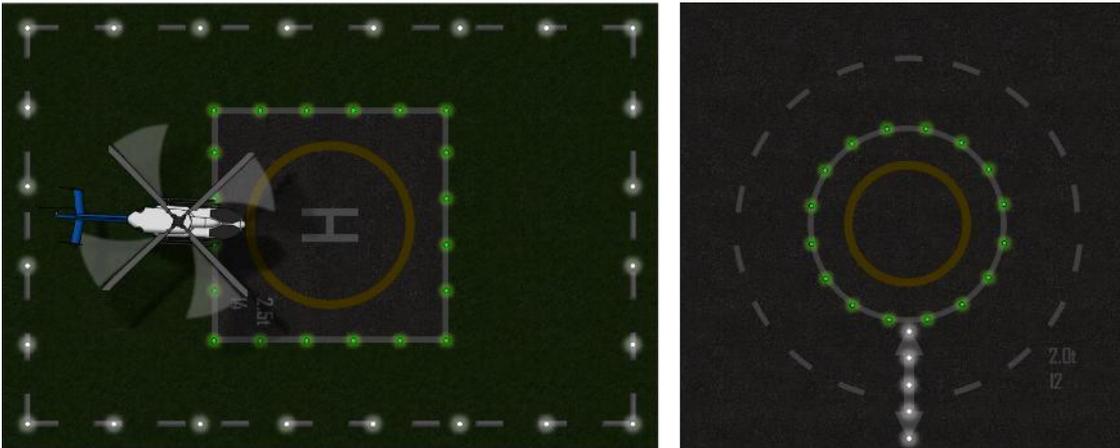


Figure 36: Lighting for FATOs with a TLOF

(Source: CASA)

5.6.2.3 Figure 36 shows examples of lighting for FATOs with a TLOF. Showing FATO perimeter lights (left) and flight path alignment lights (right) in white, and both with the TLOF lit in green.

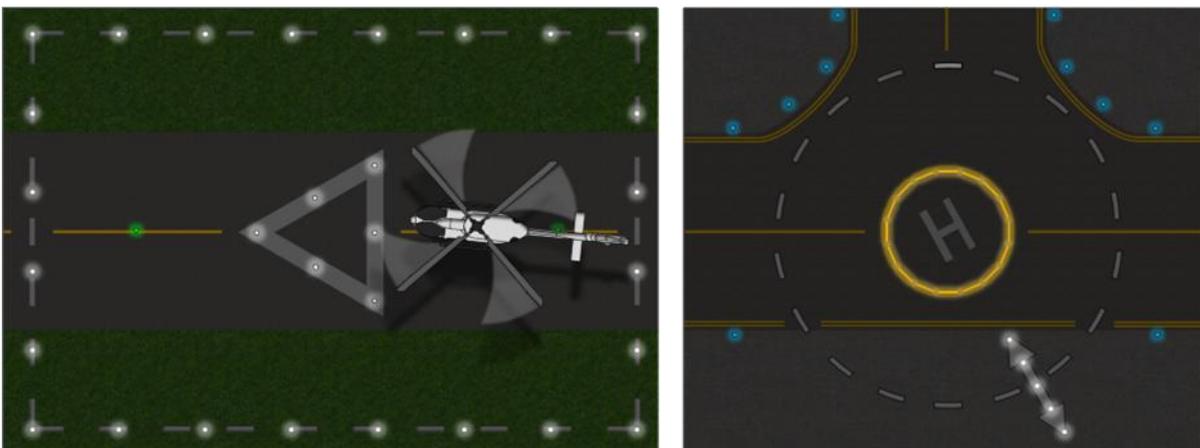


Figure 37: Lighting for FATOs on taxiways

(Source: CASA)

5.6.2.4 Figure 37 shows examples of lighting for FATOs on taxiways, one with FATO lights and an aiming point in white, and one with flight path alignment lights and a TDPC with yellow lighting segments.

5.6.3 Taxiway and taxi route lighting

5.6.3.1 Taxiways used at night for vertical flight operations, for ground taxi or an aligned air-taxi route, should be lit by either taxiway edge or centreline lighting.

Note: Refer to Chapter 9 or the Part 139 MOS for taxiway lighting specifications.

- 5.6.3.2 Where there is an air taxi-route, not aligned with a taxiway then, due to the risk of a fixed-wing aircraft inadvertently turning off the paved surface:
- a. when other vertical flight taxi-routes (aligned with lit taxiways) are available, the non-aligned taxi-route should be published as not available for night ops
or
 - b. some form of guidance should be provided to indicate the end of pavement to aircraft taxiing on the ground, such as:
 - i. Information only movement area guidance signs stating text such as "AIR TAXI"
 - ii. use of pavement edge markings.

6 Published information

6.1 Vertical flight aircraft facility data

6.1.1 Data specifications

6.1.1.1 Aerodrome operators should publish data as required under Part 175 of CASR, in alignment with the [data quality requirements \(DQR\)](#) and the data product specifications (DPS) as published by the aeronautical information service (AIS) provider.

6.1.1.2 The DQR for contains the required data specifications for:

- FATO
- TLOF
- Safety (protection) areas
- helicopter clearways
- helicopter stands.

6.1.2 Vertical flight facility symbology for aerodrome

6.1.2.1 Aerodromes should include the location of their FATOs on their aerodrome charts.

6.1.2.2 The graphical options below will provide pilots with information on the specific vertical flight facilities available at an aerodrome.

6.1.2.3 Runway type FATO symbols should be shown:

- a. with their designation at each end
(runway FATO designations should be prefixed with the letter "H")
- b. with the FATO length, in meters, written below the symbol
- c. if sealed, as a solid black rectangle
- d. if unsealed a white rectangle with black outline.

6.1.2.4 Conventional (Non-runway) FATO symbols should be shown:

- a. notated with any designation (e.g. Southern FATO)
- b. orientated with the approach direction, where applicable
- c. when associated with a TLOF, as an H in a circle
- d. when the FATO only has an aiming point only and no TLOF, shown as an H in a triangle
- e. if sealed, as a solid black icon with white text
- f. if unsealed, as a white icon with black text.

EXAMPLE ONLY

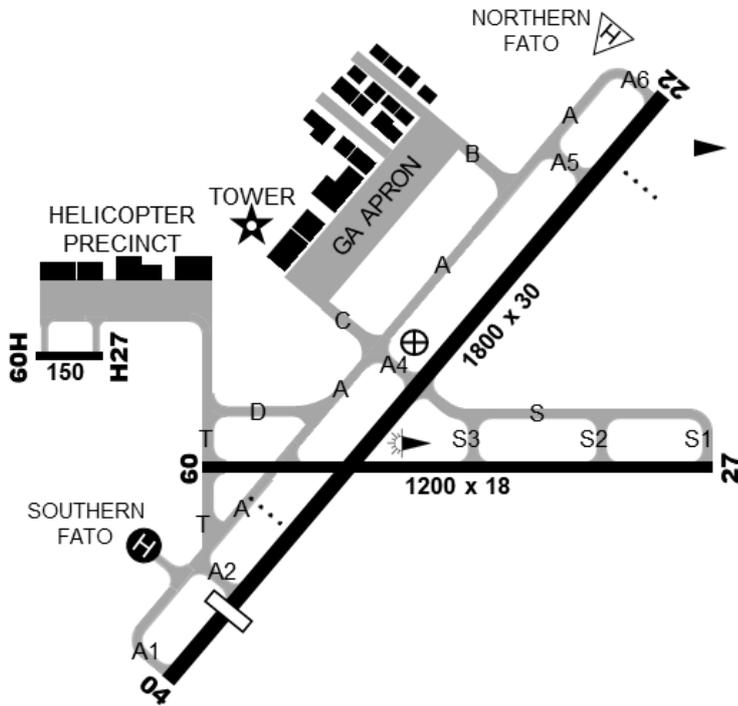


Figure 38: Fictional aerodrome diagram

(Source: CASA)

6.1.2.5 Figure 38 shows a fictional example of an aerodrome diagram showing a runway type FATO, a paved FATO (with TLOF) and an unpaved FATO with no TLOF (aiming point only).

FATO		Runway type FATO	
Sealed		Sealed	
Unsealed		Unsealed	
Aiming Point			

Figure 39: A key showing the different iconography for depicting FATOs on an aerodrome diagram

(Source: CASA)

6.1.3 Recommended ERSA data

- 6.1.3.1 Where an aerodrome has specific vertical flight facilities then the following data should be reported by the aerodrome operator to the AIS provider.
- 6.1.3.2 The data provided should be in a form, and accuracy consistent with the DQR requirements.
- 6.1.3.3 For each FATO, the following information is recommended:

Table 16: Vertical flight facility data elements

Facility	Information to publish
Runway type FATO threshold	<ul style="list-style-type: none"> • Geographical location of FATO threshold (refer to Figure 40). • Elevation of FATO threshold • Geoid undulation at FATO threshold
TLOF centre point (with or without a FATO)	<ul style="list-style-type: none"> • Geographical location of TLOF centre point (refer to Figure 40). • Elevation of TLOF centre point • Geoid undulation at TLOF centre point (centre point should be used for a FATO with an aiming point)
FATO	<ul style="list-style-type: none"> • Bearing in degrees magnetic for preferred approach • the FATO length and width in meters • the FATO surface description. (asphalt, concrete etc)
TLOF	<ul style="list-style-type: none"> • for a runway FATO - the TLOF length in meters • for a FATO with TLOF - the TLOF dimensions in meters • for a FATO with an aiming point - Note stating "Aiming point only" • TLOF surface description • TLOF pavement strength - maximum weight and tyre pressure limits (the TLOF of a runway type FATO may use PCN)
Declared distances	<ul style="list-style-type: none"> • TODAH, RTODAH and LDAH (as appropriate)
Marking and lighting	<ul style="list-style-type: none"> • Descriptions of markings and lighting
Remarks	<ul style="list-style-type: none"> • Any pertinent remarks

6.1.3.4 Aerodrome operator may choose to publish specific operations for vertical flight aircraft in their local traffic regulations section of the ERSA.

Declared distances for vertical flight facilities

6.1.3.5 The declared distances specified below are normally associated with a runway type FATO and are generally going to be associated with helicopters that are operating to a performance category. They may be applicable to future VCA operations.

6.1.3.6 Declared distances for non-runway type FATOs may be published in a slightly modified form²⁵.

Take-off distance available (helicopter)

6.1.3.7 Take-off distance available (TODAH) means the length of the FATO plus the length of helicopter clearway (if provided) declared available and suitable for helicopters to complete the take-off.

6.1.3.8 Where a clearway is provided then the TODAH will be the FATO length, the length of the clearway, plus the safety/protection area that is located between the two.

Note: Refer to AC 139.R-01 section 4.1 for details on helicopter clearways.

²⁵ Refer to Figure 40.

Rejected take-off distance available (helicopter)

6.1.3.9 Rejected take-off distance available (RTODAH) means the length of the FATO declared available and suitable for helicopters operated in certain performance classes.

Landing distance available (helicopter)

6.1.3.10 Landing distance available (LDAH) means the length of the FATO plus any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a defined height.

Note: Where a FATO is provided that is not suitable for supporting the dynamic weight of an aircraft, such as non-weight bearing grass, or a FATO over water, then all declared distances will be determined by the dimensions of the TLOF.

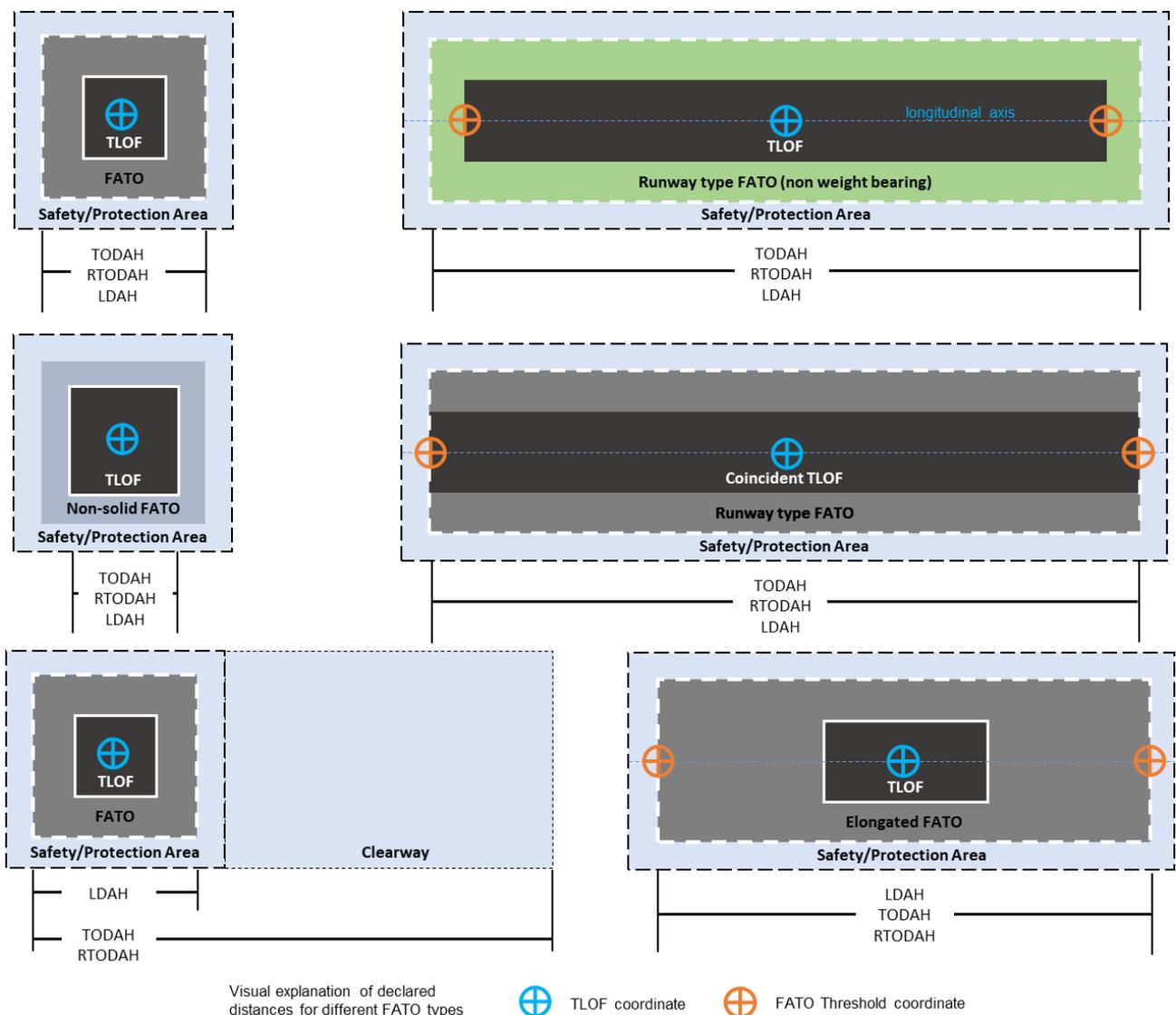


Figure 40: Visual explanation of declared distances and coordinate locations for different FATO types

(Source: CASA)

6.1.4 Aerodrome manual data

6.1.4.1 The operator of a certified aerodrome with vertical flight facilities should record all published data in their aerodrome manual.

6.1.5 Vertical flight ground movement charts

6.1.5.1 Where an aerodrome wishes to specify ground taxi-routes, air-taxi routes, air transit route, or where they wish to allow or prohibit vertical flight aircraft operations from using a particular area(s), then an aerodrome operator may choose to publish a helicopter specific ground movement chart.

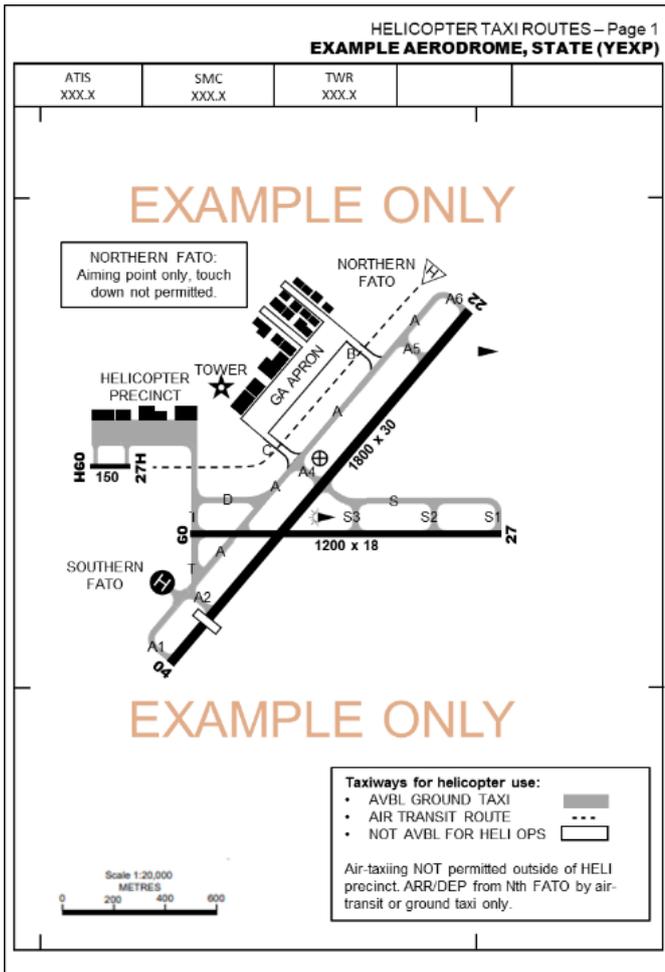


Figure 41: Ground movement chart

(Source: CASA)

6.1.5.2 Figure 41 shows a fictitious example of published ground movement chart for available the air transit route and prohibited area for vertical flight aircraft movements at a fictitious aerodrome.